SOIL SURVEY OF

Boone County, Nebraska

U. S. Department of Agriculture
Soil Conservation Service
In Cooperation With
University of Nebraska
Conservation and Survey Division

Issued January 1972

Major fieldwork for this soil survey was done in the period 1959 to 1963. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1969. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska, Conservation and Survey Division. It is part of the technical assistance furnished to the Boone County Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, USDA, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Boone County contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Boone County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county by map symbol. It shows the page where each kind of soil is described, and also the page for the capability unit, range site, and windbreak suitability group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of capability units, range sites, and windbreak suitability groups.

Game managers, sportsmen, and others concerned with wildlife will find information about soils and wildlife in the section "Wildlife and Recreation."

Ranchers and others interested in range can find, under "Range Management," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices and designs.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Boone County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County."

Cover Picture:

Terraces, waterways, and windbreaks on soils of the Moody, Nora, and Hord soils.

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Washington, D.C. 20402

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SOIL SURVEY OF BOONE COUNTY, NEBRASKA

BY CHARLES L. HAMMOND, CHARLES F. MAHNKE, LAURENCE BROWN, RONALD SCHULTE, AND WALTER RUSSELL, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE UNIVERSITY OF NEBRASKA CONSERVATION AND SURVEY DIVISION

BOONE COUNTY is near the center of the eastern half of Nebraska (fig. 1). Albion, the county seat

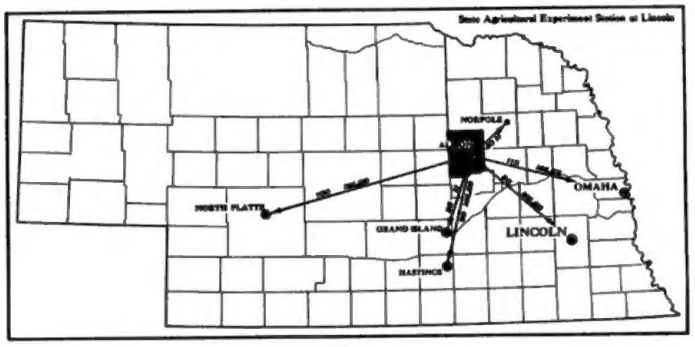

Figure 1.--Location of Boone County in Nebraska.

and largest town, is near the center of the county. The total land area is 683 square miles, or 437,120 acres.

The county consists of loessial uplands, alluvial terraces and bottom lands, and sandhills. Relief ranges from nearly level to steep, but it is dominantly moderately sloping. The county is drained by Shell Creek, Beaver Creek, Plum Creek, and the Cedar River, which flow in a northwest to southeast direction.

Indians of the Omaha, Sioux, and Pawnee tribes lived in Boone County at the time the first homestead was established in 1871. The settlers made their homes of sod or dug holes into the side of a hill or a ravine and used these dugouts as their homes. Most of the early settlers came from other parts of the United States. Severe winters and drought, however, limited settlement. After 1900 the population gradually increased until the 1930's when another severe drought caused many farmers to leave the county. According to the U.S. Census, a total of 8,093 persons were living in the county in 1970.

Schools and churches are accessible to all residents, and a hospital, a convalescent home, and a home for the the elderly are also available. In most towns bus service is provided for rural high school students.

Farming is the principal enterprise. Corn, sorghum, and alfalfa are the major crops, though small grains are also grown. Cropland makes up about 70 percent of the acreage, and about 8 percent of this is irrigated. Range and pasture account for about 25 percent of the acreage, and woodland makes up the remaining 5 percent. Raising cattle and hogs for meat is the major livestock enterprise, but some dairy cattle are raised.

Farm products and the marketing of these products are the source of the main industries. Several feed mills and fertilizer plants are in the county. Other major industries include lumber yards, well drilling and ready mix cement plants, and gravel pits. A natural gas pumping plant, two electric companies, and several telephone companies also serve the county.

State and county roads provide the main transportation in Boone County. State highways connect the main communities, and county highways service all parts of the county. Roads are on most section lines, though they are scarce in the Sandhills.

Several trucking companies in the county or in nearby counties haul most of the freight and livestock to market. Branch lines of the Union Pacific and of the Chicago and Northwestern railroads also provide freight service, but passenger service is limited. A community airport northwest of Albion serves the county. A few privately owned airplanes and landing fields are also in the county.

Pheasant hunting is one of the most popular sports in the county, but deer, quail, and ducks are also hunted. Most fishing is done in the Cedar River and Beaver Creek. Some gravel pits and farm ponds, however, have been stocked with fish. Boating and water skiing are limited to the gravel pits and farm ponds. Among the other recreational facilities are parks, swimming pools, lighted athletic fields, a golf course, and a county fair grounds.

HOW THIS SURVEY WAS MADE

Soil scientists made this survey to learn what kinds of soil are in Boone County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and the soil phase are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Nora and Valentine, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Hord silt loam, 0 to 1 percent slopes, is one of several phases within the Hord series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Boone County: soil complexes, and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Crofton-Nora silt loams, 17 to 30 percent slopes is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Hord and Ortello fine sandy loams, 1 to 3 percent slopes is an example.

In most areas surveyed there are places where the soil material is so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Blown-out land is a land type in Boone County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of rangeland, engineers, and homeowners.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

GENERAL SOIL MAP

The general soil map at the back of this survey shows, in color, the soil associations in Boone County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, drainage, or other characteristics that affect management.

The eight soil associations in Boone County are described in the following pages.

1. Valentine Association

Excessively drained, gently sloping to strongly sloping soils that are sandy throughout; on uplands

This association consists mainly of soils on broad, smooth, rounded and peaked hills and in small valleys (fig. 2).It is made up of excessively drained, gently sloping to strongly sloping soils that formed in wind-laid sandy material. This association is the eastern extension of the area known as the "Nebraska Sandhills." It is in the northwestern part of the county.

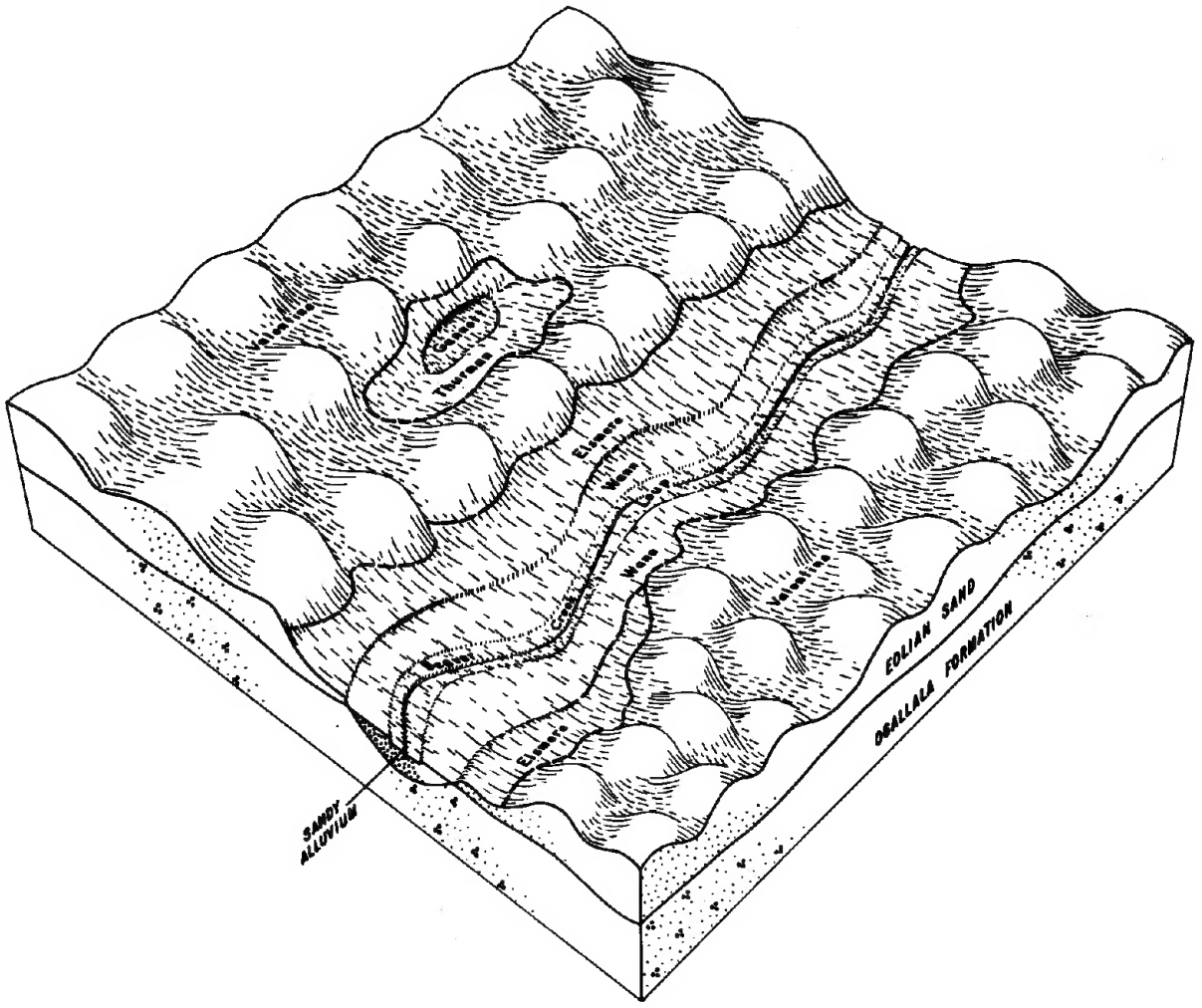

Figure 2.--Typical pattern of soils in associations 1 and 2.

This association makes up about 8 percent of the county. Valentine soils make up about 90 percent of this association; and minor soils, the remaining 10 percent.

The deep Valentine soils have a thin surface layer of fine sand or loamy sand.

Minor soils of this association are the Gannett and Thurman. Also in this association are many areas of the land type Blown-out land. Gannett soils are sandy and are in depressions that are wet most of the year. The gently sloping Thurman soils have a thick, loamy fine sand surface layer; a loamy sand subsoil; and a fine sand substratum. Blown-out land consists of severely eroded areas that have little vegetative cover and are constantly being shifted about by wind. The areas range from small hollows to large dunes.

Most of this association is in native grass used for range. The Valentine soils are too sandy, unstable, and droughty for cultivation, and the other soils generally occur in small areas surrounded by Valentine soils. The chief concern of management is overgrazing, which damages the vegetative cover and makes the soil susceptible to severe soil blowing.

Abundant forage is produced on the soils of this association, and large herds of beef cattle are pastured on the areas. A good supply of water for livestock is readily available at a depth of 15 to 50 feet. The farms and ranches in this association are larger than elsewhere in the county. Good roads are scarce, and most of the roads do not follow section lines.

2. Elsmere-Wann-Loup Association

Somewhat poorly drained and poorly drained, nearly level to gently sloping, sandy and loamy soils on bottom lands and stream terraces

This association consists of nearly level to gently sloping soils on terraces and bottom lands along Beaver Creek in the northwestern part of the county (see fig. 2).

This association makes up about 2 percent of the county. Elsmere soils make up about 40 percent of the association; Wann soils, 23 percent; Loup soils, 14 percent; and minor soils, the remaining 23 percent.

The somewhat poorly drained Elsmere soils are on low hummocky terraces between the Sandhills and the bottom lands. They have a fine sand to loamy fine sand surface layer over a mottled fine sand substratum. The water table is at a depth of 2 to 6 feet.

The nearly level, somewhat poorly drained Wann soils are on bottom lands between Elsmere and Loup soils. They have a calcareous surface layer of loam or fine sandy loam and a subsoil of fine sandy loam. The substratum is fine sand. The water table is at a depth of 2 to 6 feet.

The poorly drained Loup soils are along Beaver Creek. They have a loam surface layer over a fine sand substratum. The water table is at a depth of 2 feet for most of the year.

Minor soils of this association are Gannett, Lamo, and Leshara. Also in this association are many areas of the land types Marsh and Wet alluvial land. Gannett soils are sandy and are in depressions. Lamo and Leshara soils are somewhat poorly drained and are silty. Wet alluvial land is poorly drained to very poorly drained and is silty.

Soils of this association are used mostly for range or for native hay, and large herds of beef cattle are pastured on the areas. Most of the Elsmere soils are too sandy or too unstable for cultivation, and the Loup soils are too wet. Small acreages of the Elsmere and Wann soils, however, are cultivated.

Careful management is needed in all areas for control of erosion and to maintain fertility. In cultivated areas the chief concern of management is a high water table in spring that delays planting. On all areas a cover of vegetation is needed for control of soil blowing.

Good roads are scarce in this soil association.

3. Thurman-Hord-Loretto Association

Somewhat excessively drained and well drained, nearly level to rolling, sandy and silty soils on uplands

In this association are nearly level to rolling soils that formed in wind-laid silty and sandy material on uplands.

This association makes up about 7 percent of the county. Thurman soils make up about 33 percent of this association; Hord soils, about 26 percent; Loretto soils, about 18 percent; and minor soils, the remaining 23 percent.

Thurman soils are nearly level to moderately sloping and are somewhat excessively drained. They have a thick surface layer of loamy fine sand. The subsoil is loamy fine sand, and the substratum is fine sand.

Hord soils are nearly level to very gently sloping and are well drained. They have a thick surface layer of silt loam. Their subsoil is silt loam, and their substratum is loess.

Loretto soils are very gently sloping to gently sloping and are well drained. They have a surface layer of fine sandy loam, loam, or loamy fine sand. Their subsoil is silt loam, and their substratum is loam.

Minor soils of this association are Crofton, Hobbs, and Nora. These soils are very gently sloping to steep. Crofton soils are thin and silty. Hobbs soils are silty and are in narrow upland drainageways. Nora soils have a moderately thick surface layer of silt loam. Their subsoil is calcareous silt loam, and their substratum is silty loess.

The nearly level to gently sloping soils in this association are used for cultivated crops. The strongly sloping to steep soils are in native grass and are used for range. Some of the

nearly level and very gently sloping soils are irrigated.

On the gently sloping soils, controlling water erosion and soil blowing and maintaining tilth and fertility are the main concerns. The farms in this association are used mainly for growing grain and raising livestock. On most of the farms, some cattle and hogs are fed for market. Good gravel roads follow most section lines.

4. Nora-Crofton-Moody Association

Well-drained to excessively drained, gently sloping to steep, silty soils on uplands

In this association are gently sloping to steep soils that are well drained to excessively drained. These soils formed in wind-laid silty material on uplands (fig. 3).

This association makes up about 65 percent of the county. Nora soils make up about 58 percent of this association; Crofton soils, about 25 percent; Moody soils, about 10 percent; and minor soils, the remaining 7 percent.

Nora soils are moderately sloping to strongly sloping and are well drained. They have a moderately thick surface layer of dark-colored silt loam. Their subsoil is silt loam, and their substratum is calcareous silty loess.

Crofton soils are moderately sloping to steep. They are well drained, where the slopes are moderate, and excessively drained, where the slopes are steep. They have a thin surface layer of silt loam. Their substratum is calcareous silty loess.

Moody soils are gently sloping. They have a moderately thick surface layer of silty clay loam. The subsoil is silty clay loam underlain by loess.

Minor soils of this association are Belfore, Hobbs, and Hord. The nearly level Belfore soils are on uplands flats. The occasionally flooded Hobbs soils are on narrow upland drainageways. The Hord soils are on the base of colluvial slopes and on nearly level uplands in the southwestern part of the county.

The gently sloping to strongly sloping soils in this association are used for cultivated crops. The steep soils are mainly in native grass and are used for range. Some of the steep soils have been cultivated, but many of the steep areas have been seeded to native grass.

Careful management is needed on these soils for control of water erosion and to maintain tilth and fertility. The farms in this association are used mainly for growing grain and raising livestock. On most of the farms, some cattle and hogs are fed for market. Good gravel or hard surface roads follow most section lines.

5. Hobbs Association

Well-drained, nearly level, silty soils on bottom lands that are subject to occasional flooding

In this association are well-drained, nearly level soils that formed in silty material. These soils are on bottom lands along Shell Creek, Plum Creek, and Vorhees Creek, and they are occasionally flooded.

This association makes up about 5 percent of the county. Hobbs soils make up about 90 percent of this association; and minor soils, the remaining 10 percent.

Hobbs soils have a thick surface layer of silt loam. The subsoil is silt loam and the substratum is silty. The narrow upland drainageways are subject to occasional flooding. The soils on the wider bottom lands, however, are well drained. The soils that are occasionally flooded consist of stratified recent alluvium that is 6 to 12 inches thick over a dark-colored buried soil.

Minor soils of this association are the Hall and Hord, and areas of the land type Silty alluvial land. Hall and Hord soils are on stream terraces between the uplands and the bottom lands. Silty alluvial land is on channelled silty bottom lands that are frequently flooded.

Most of this association is cultivated. Hobbs soils are well suited to irrigation, and many of them are irrigated. Silty alluvial land is suited only to trees and pasture.

The farms in this association are used mainly for growing grain and raising livestock. On most of the farms some cattle and hogs are fed for market. Good gravel or hard surface roads follow most section lines.

6. Hall-Hord Association

Well-drained, nearly level to gently sloping, silty soils on stream terraces

In this association are well-drained, nearly level to gently sloping soils. These soils are on terraces along Cedar River, Beaver Creek, and other streams in the county (see fig. 3).

This association makes up about 10 percent of the county. Hall soils make up about 48 percent of this association; Hord soils, about 43 percent; and minor soils, the remaining 9 percent.

Hall soils are nearly level to very gently sloping. They have a thick surface layer of silt loam. The subsoil is silty clay loam, and the substratum is silt loam. A few areas of Slickspots are included with the Hall soils.

Hord soils are nearly level to very gently sloping. They have a thick surface layer and a silt loam texture throughout.

Minor soils of this association are the Fillmore and Moody. Fillmore soils are in depressions. Moody soils are gently sloping. They have a surface layer and subsoil of silty clay loam and a substratum of silt loam.

Nearly all areas of this association are cultivated, and most are irrigated. The main concerns are good management of irrigation water and maintaining soil fertility. The farms are used mainly

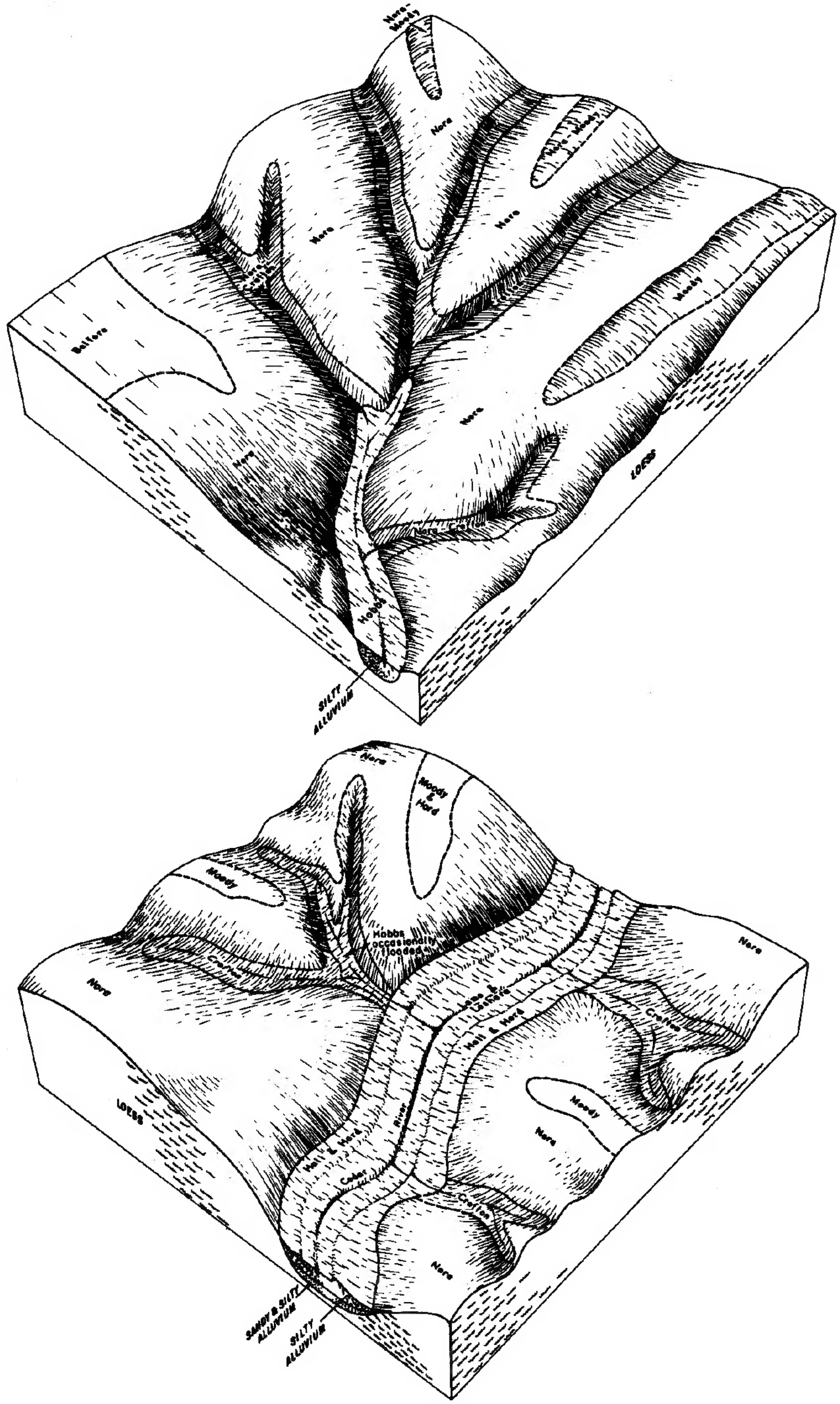

Figure 3.--Two diagrams showing typical pattern of the soils in three associations. The upper diagram shows the soils in association 4, and the lower one, the soils in associations 4, 6, and 8.

for growing grain and raising livestock. On most of the farms, some cattle and hogs are fed for market. Good gravel or hard surface roads follow most section lines.

7. Belfore-Moody Association

Well-drained, nearly level and very gently sloping, silty soils on uplands

In this association are well-drained, nearly level and very gently sloping soils. These soils formed in wind-laid silty material on uplands.

This association makes up about 2 percent of the county. Belfore soils make up about 45 percent of this association; Moody soils, about 45 percent; and minor soils, the remaining 10 percent.

The nearly level Belfore soils have a thick surface layer of silt loam and silty clay loam. The subsoil is silty clay loam, and the substratum is silty loess.

The very gently sloping Moody soils are on table lands and ridgetops. They have a thick surface layer of silty clay loam. Their subsoil is silty clay loam, and their substratum is silty loess.

Minor soils of this association are the Fillmore and Nora. Fillmore soils are in depressions, and the moderately sloping Nora soils are near drainageways. Fillmore soils generally are used the same as the surrounding soils.

The main concerns of management are maintaining fertility on the nearly level soils and controlling water on the very gently sloping soils.

The farms in this association are used mainly for growing grain and raising livestock. On most of the farms some cattle and hogs are fed for market. Good gravel or hard surface roads follow most section lines.

8. Leshara-Lamo-Wann Association

Somewhat poorly drained, nearly level, silty and loamy soils on bottom lands

In this association are somewhat poorly drained, nearly level soils. These soils are on bottom lands along Beaver Creek and the Cedar River (see fig. 3). They have a water table at a depth between 2 and 6 feet.

This association makes up about 1 percent of the county. Leshara soils make up about 48 percent of this association; Lamo soils, 43 percent; Wann soils, 8 percent; and minor soils, the remaining 1 percent.

Leshara soils have a thick surface layer of silt loam. The next layer to a depth of about 34 inches is stratified, calcareous silt loam. Below this to a depth of about 48 inches is mottled, highly stratified, very fine sandy loam. The water table is at a depth between 3 and 6 feet.

Lamo soils have a thick, calcareous surface layer of silty clay loam. Below this to a depth of more than 60 inches is calcareous silty clay loam. The water table is at a depth between 2 and 6 feet.

Wann soils have a thick, calcareous surface layer of loam or fine sandy loam. The subsoil is calcareous, mottled fine sandy loam, and the substratum is loamy sand to fine sand.

Minor soils of this association are the Cass and Inavale and areas of the land type Wet alluvial land. Inavale soils have a thin surface layer of loamy fine sand or fine sandy loam underlain by fine sand. Cass soils have a thick surface layer of loam underlain by fine sand. Depth to the water table in Wet alluvial land ranges from 0 to 2 feet.

Most of this association is cultivated and is used chiefly for growing crops common to the county. Many areas are irrigated, and some are used for native hay and pasture. The main concerns of management are the high water table in spring that delays planting and maintaining soil tilth and fertility.

The few farms in this association are used mostly for growing grain and raising livestock. Most of the farms some cattle and hogs are fed for market. Good gravel roads follow most section lines, and where they are near rivers, they parallel the rivers. Bridges across the rivers are placed only a few miles apart.

This section describes the soil series and mapping units of Boone County in alphabetical order. The procedure is first to describe the soil series, and then the mapping units in that series. Thus, to get full information on any mapping unit, we need to read the description of that unit and the description of the soil series to which it belongs.

Each series contains a short nontechnical description of a representative soil profile and a much more detailed description of the same profile that scientists, engineers, and others can use in making highly technical interpretations. This profile is considered representative for all the soils of the series. If a profile for a given mapping unit differs from this representative profile, the differences are stated in the description of the mapping unit, unless the differences are apparent in the name of the mapping unit. The included soils named in the descriptions of the mapping units do not necessarily occur in all areas of the mapping unit, but they do occur in some areas.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Blown-out land, for example, does not belong to a soil series, but, it is listed in alphabetical order along with the soil series.

In describing the typical profile, the color of each horizon is described in words, such as yellowish brown, but it can also be indicated by symbols for the hue, value, and chroma, such as 10YR 5/4. These symbols, called Munsell color notations (6), 1/ are used by soil scientists to evaluate the color of the soil precisely. For the profiles described, the names of the colors and the color symbols are for dry soil unless stated otherwise.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit, range site, and windbreak suitability group, in which the mapping unit has been placed. The page on which each group is described can be found by referring to the "Guide to Mapping Units" at the back of this survey. Many terms in the soil descriptions and in other parts of the survey are defined in the Glossary. The acreage and proportionate extent of the mapping units are shown in table 1. The location of the soils in Boone County are shown on the detailed map at the back of this survey. The names of some soils in this survey may differ from those in areas of adjacent counties because of changes in classification or differences in the detail of mapping.

Belfore Series

The Belfore series consists of deep, well-drained, nearly level soils. These soils formed in loess on uplands.

In a representative profile the surface layer is dark grayish brown and is about 12 inches thick. It is silt loam in the upper half and silty clay loam in the lower half. The subsoil is silty clay loam about 37 inches thick. It is dark brown in the upper 22 inches and brown in the lower 15 inches. Below this is pale-brown, friable, silt loam loess that is many feet thick and has a lime layer at a depth of about 59 inches.

The surface layer of Belfore soils is slightly acid, and the subsoil is neutral. Permeability is moderately slow, available water capacity and fertility are high, and runoff is slow. Belfore soils are easy to till.

These soils are suited to dryland and irrigated crops. Most of the acreage is cultivated, and some of it is gravity irrigated by deep wells. Corn and sorghum are the main crops grown, but all crops commonly grown in the county are suited.

Representative profile of Belfore silt loam, 0 to 1 percent slopes, (0.4 mile west and 0.35 mile south of the northeast corner, sec. 28, T. 21 N., R. 5 W.):

Ap--0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, friable when moist; slightly acid; abrupt, smooth boundary.

A1--6 to 12 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular; slightly hard when dry, firm when moist; neutral; clear, wavy boundary.

B1--12 to 20 inches, dark-brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) when moist; moderate, medium, subangular blocky structure that parts to moderate, fine, blocky; hard when dry, firm when moist; neutral; peds are glazed; clear, wavy boundary.

B2t--20 to 34 inches, dark-brown (10YR 4/3) silty clay loam, dark yellowish brown (10YR 3/4) when moist; moderate, coarse, angular blocky structure that parts to moderate, medium, angular blocky; hard when dry, firm when moist; neutral; peds are glazed; clear, wavy boundary.

B3--34 to 49 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; moderate, coarse, prismatic structure that parts to moderate, fine, subangular blocky; hard when dry, firm when moist; neutral; clear, wavy boundary.

C1--49 to 59 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; soft when dry, friable when moist; neutral; gradual, wavy boundary.

C2ca--59 to 66 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; soft when dry,

1/ Underscored numbers in parenthesis refer to Literature Cited, p. 77.

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Soil	Acres	Percent	Soil	Acres	Percent
Belfore silt loam, 0 to 1 percent slopes	7,855	1.8	Loretto fine sandy loam, 3 to 7 percent slopes, eroded	1,420	0.3
Blown-out land	2,392	.5	Loretto loam, 3 to 7 percent slopes, eroded	3,422	.8
Cass soils	695	.2	Loretto-Nora fine sandy loams, 7 to 12 percent slopes, eroded	707	.2
Crofton silt loam, 7 to 17 percent slopes, eroded	833	.2	Loup loam	1,292	.3
Crofton silt loam, 17 to 30 percent slopes, eroded	18,220	4.2	Marsh	174	(1/)
Crofton-Nora silt loams, 7 to 12 percent slopes, eroded	27,216	6.2	Moody silty clay loam, 1 to 3 percent slopes	15,320	3.5
Crofton-Nora silt loams, 12 to 17 percent slopes, eroded	27,553	6.3	Moody silty clay loam, 1 to 3 percent slopes, eroded	880	.2
Crofton-Nora silt loams, 17 to 30 percent slopes	26,059	6.0	Moody silty clay loam, 3 to 7 percent slopes, eroded	15,645	3.6
Elsmere fine sand	1,936	.4	Nora silt loam, 7 to 12 percent slopes	10,272	2.3
Elsmere loamy fine sand	1,624	.4	Nora silt loam, 7 to 12 percent slopes, eroded	124,650	28.5
Fillmore silt loam	726	.2	Nora-Crofton silt loams, 12 to 17 percent slopes	1,874	.4
Gannett fine sandy loam	132	(1/)	Nora-Moody complex, 3 to 7 percent slopes, eroded	3,435	.8
Hall silt loam, 0 to 1 percent slopes	13,823	3.2	Sandy alluvial land	191	(1/)
Hall silt loam, 1 to 3 percent slopes	3,931	.9	Silty alluvial land	2,792	.6
Hall-Slickspots complex, 1 to 3 percent slopes	1,680	.4	Thurman loamy fine sand, 0 to 3 percent slopes	1,626	.4
Hobbs silt loam, 0 to 1 percent slopes	8,421	1.9	Thurman loamy fine sand, 3 to 7 percent slopes	7,030	1.6
Hobbs silt loam, 0 to 1 percent slopes, occasionally flooded	20,116	4.6	Thurman loamy fine sand, 7 to 12 percent slopes	1,152	.3
Hord silt loam, 0 to 1 percent slopes	4,826	1.1	Thurman loamy fine sand, silty substratum, 0 to 3 percent slopes	505	.1
Hord silt loam, 1 to 3 percent slopes	16,076	3.7	Thurman loamy fine sand, terrace, 0 to 3 percent slopes	806	.2
Hord silt loam, 3 to 7 percent slopes	2,602	.6	Thurman-Valentine complex, 0 to 3 percent slopes	352	.1
Hord silt loam, terrace, 0 to 1 percent slopes	11,437	2.6	Valentine fine sand, rolling	25,211	5.8
Hord silt loam, terrace, 1 to 3 percent slopes	720	.2	Valentine loamy fine sand, undulating	6,340	1.4
Hord and Ortello fine sandy loams, 1 to 3 percent slopes	1,207	.3	Wann loam	2,585	.6
Inavale soils	248	.1	Wet alluvial land	981	.2
Inavale soils, wet	301	.1	Water area	663	.1
Lamo silty clay loam	2,471	.6	Gravel pits	31	(1/)
Leshara silt loam	2,799	.6			
Loess hills and bluffs	236	(1/)			
Loretto fine sandy loam, 0 to 3 percent slopes, eroded	1,629	.4	Total	437,120	100.0

1/ Less than 0.05 percent.

friable when moist; mildly alkaline; calcareous spots, but matrix is noncalcareous.

The A horizon ranges from 10 to 12 inches in thickness. The B horizon ranges from 36 to 40 inches in thickness. Depth to lime ranges from 50 to 66 inches.

Belfore soils are associated with Moody and Fillmore soils. They have a thicker B horizon and are deeper to lime than Moody soils. Belfore soils have a lower content of clay in the B horizon than Fillmore soils, and they are better drained than those soils.

Belfore silt loam, 0 to 1 percent slopes (Be).--This is the only Belfore soil mapped in the county. It is on upland divides throughout the eastern two-thirds of the county. The areas are irregular in shape and range from 10 to several hundred acres in size.

Included with this soil in mapping were small depressional areas of Fillmore silt loam that are shown on the detailed map by a special symbol. Also included were small areas of Moody silty clay loam, 1 to 3 percent slopes.

Nearly all of this Belfore soil is cultivated. This soil is suited to all of the local crops, but corn, sorghum, alfalfa, and small grains are the main crops grown. This soil is also suited to grass, to trees, and to other less intensive uses. It is suitable for irrigation but many of the areas are too irregular in shape to irrigate efficiently. Proper water management and maintaining tilth and fertility are the chief concerns of management. Capability unit I-1, dryland, and I-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Blown-Out Land

Blown-out land (3 to 17 percent slopes) (B) consists of hummocky areas of fine sand that have no soil layers or structure. It occurs within areas of Valentine soils in patches of 5 to 150 acres. The areas are made up of one large blowout or of several small ones.

Included with this land type in mapping were small swales and lakes and small areas of Elsmere fine sand and of Valentine fine sand, rolling.

Little or no vegetation grows on Blown-out land, and the sand shifts freely with the wind. Most areas are near wells that provide a supply of water. If the cattle overgraze areas near the wells, the areas become bare and subject to soil blowing (pl. I). If the areas are fenced and the livestock kept out, vegetation will grow on them and stabilize them. Some of the steeper areas need to be leveled and seeded. Capability unit VIIe-5, dryland; Sands range site; Very Sandy windbreak suitability group.

Cass Series

The Cass series consists of deep, well-drained soils on bottom lands along the Cedar River and Beaver Creek. These soils formed in sand laid down by water. Depth to the water table ranges from 6 to 15 feet. Cass soils are subject to flooding when the streams overflow, but the floods generally do not last long.

In a representative profile the surface layer is loam about 13 inches thick. It is grayish brown in the upper 7 inches and very dark grayish brown in the lower 6 inches. The next layer, about 6 inches thick, is dark grayish-brown fine sandy loam. Below is grayish-brown loamy sand about 7 inches thick, and then light brownish-gray fine sand to a depth of 60 inches.

Cass soils are neutral in reaction. Permeability is moderately rapid below the surface layer. Available water capacity is moderate to low, and fertility is medium. Runoff is slow. The soils are easy to work.

These soils are suited to cultivated crops, to range, and to trees. Most areas are small and are surrounded by poorly drained soils and are therefore in native grass. In areas that are cultivated, corn, sorghum, and alfalfa are the main crops. Mid and tall grasses are the main plants on properly managed range.

Representative profile of Cass loam in an area of Cass soils, in a pasture 150 feet north of old river channel, (150 feet south and 0.4 mile east of northwest corner of sec. 12, T. 18 N., R. 5 W.):

Ap--0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; cloddy to weak, fine, granular structure; slightly hard when dry, very friable when moist; neutral; abrupt, smooth boundary.

A1--7 to 13 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; neutral; abrupt, smooth boundary.

AC--13 to 19 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure that parts to single grain; slightly hard when dry, friable when moist; neutral; clear, wavy boundary.

C1--19 to 26 inches, grayish-brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry and moist; neutral; clear, wavy boundary.

C2--26 to 48 inches, light brownish-gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) when moist; single grain; loose when dry, and moist; neutral; gradual, wavy boundary.

C3--48 to 60 inches, light brownish-gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry and moist; neutral; a few iron stains.

The A horizon ranges from 10 to 20 inches in thickness. It is dominantly loam in texture, but it ranges from silt loam to fine sandy loam. The AC horizon is 5 to 10 inches thick.

Cass soils in Boone County are less acid and have fine sand higher in the profile than is typical for the series, but these differences do not alter their usefulness and behavior.

Cass soils are next to Wann and Inavale soils. They are better drained than the Wann soils, and they are not so sandy as the Inavale soils.

Cass soils (0 to 1 percent slopes) (Cz).--These soils are adjacent to and parallel to Beaver Creek and the Cedar River. Their surface layer is mainly loam, but it ranges from silt loam to fine sandy loam.

Cass soils are used for dryland crops and for range, but most areas are in native range or tame pasture. The native vegetation is mid and tall grasses. If these soils are cultivated, the main concerns of management are maintaining tilth and fertility. Corn, sorghum, and alfalfa are the main crops grown, but this soil is suited to other local crops. This soil is also suited to trees and to other less intensive uses. Capability unit I-1, dryland, and I-1, irrigated; Sandy Lowland range site; Silty to Clayey windbreak suitability group.

Crofton Series

The Crofton series consists of deep, well drained to excessively drained, moderately sloping to steep soils. These soils formed in loess on uplands.

In a representative profile the surface layer is dark grayish-brown silt loam about 4 inches thick. The next layer, about 3-inches thick, is grayish-brown silt loam. Below this is light yellowish-brown, calcareous silt loam to a depth of 60 inches.

The surface layer of Crofton soils is mildly alkaline, and the substratum is moderately alkaline. Permeability is moderate, available water capacity is high, and fertility is low. Runoff is rapid.

If Crofton soils are cultivated, they are highly susceptible to erosion. The moderately sloping soils are suited to limited use for cultivated crops. The steep soils are better suited to native grass than to cultivated crops.

Representative profile of a Crofton silt loam, in an area of Crofton-Nora silt loams, 17 to 30 percent slopes, in a field of native grass on a slope of 20 percent (850 feet south and 0.35 mile west of the northeast corner of sec. 32, T. 20 N., R. 6 W.):

A1--0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; mildly alkaline; clear, wavy boundary.

AC--4 to 7 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; calcareous; moderately alkaline; many concretions; clear, wavy boundary.

Cca--7 to 60 inches, light yellowish-brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) when moist; many, prominent, reddish-brown mottles; weak, coarse, prismatic structure; soft when dry; very friable when moist; calcareous; moderately alkaline; many medium to coarse lime concretions.

The A horizon ranges from 0 to 6 inches in thickness, and it is grayish brown or pale brown in eroded areas. The AC horizon ranges from 3 to 6 inches in thickness. The C horizon ranges from light yellowish brown to light brownish gray.

Crofton soils are associated with Nora and Moody soils. They have a thinner A horizon than the Nora and Moody soils and also have lime nearer the surface. Crofton soils have a lower content of clay throughout the profile than Moody soils.

Crofton silt loam, 7 to 17 percent slopes, eroded (CfD2).--This well-drained soil is on short side slopes and narrow, rounded ridgetops in areas of 5 to 50 acres. The surface layer is lighter colored than that in the profile described as representative of the series. Also, lime concretions are on the surface.

Included with this soil in mapping were small areas of Nora silt loam, 7 to 12 percent slopes, eroded.

If this Crofton soil is cultivated, the erosion hazard is moderate to severe. Organic-matter content and fertility are low.

This soil is suited to limited use for row crops, and most of it is cultivated. Corn, sorghum, and alfalfa are the main crops grown, but all of the local crops are suited. Controlling erosion and maintaining fertility are the chief concerns of management. Capability unit IVe-8, dryland; Limy Upland range site; Silty to Clayey windbreak suitability group.

Crofton silt loam, 17 to 30 percent slopes, eroded (CfE2).--This excessively drained soil is on the steep side slopes adjacent to drainageways throughout the silty uplands. Much of the original surface layer has been eroded away and the silt loam substratum is at the surface. Many lime pebbles are on the surface.

Included with this soil in mapping were small areas of Hobbs silt loam, 0 to 1 percent slopes, occasionally flooded, and of Nora silt loam, 7 to 12 percent slopes, eroded. Also included were small areas next to the Sandhills that have stratified layers of sand.

Steep slopes and rapid runoff make this soil better suited to native grass than to cultivated crops. All the acreage is cultivated or has been cultivated, but some areas have been seeded to permanent native grass or bromegrass. This soil is also suited to trees and to other less intensive uses. Capability

unit VIe-8, dryland; Limy Upland range site; Silty to Clayey windbreak suitability group.

Crofton-Nora silt loams, 7 to 12 percent slopes, eroded (CNC2).--These well-drained soils occupy long, narrow areas in the silty uplands. The areas are irregular in shape and average 5 to 40 acres in size. Some areas, however, are as much as 100 acres or more.

About 50 to 70 percent of this complex is Crofton soil, and about 30 to 50 percent is Nora soil. The Crofton soil is light colored and is near the head of drainageways on narrow ridgetops. The Nora soil is dark colored and occurs below the ridgetops on the upper part of side slopes. Because of their contrasting colors, plowed areas of these soils have a patchy appearance. The Crofton soil is less sloping, but its profile is similar to the one described as representative of the Crofton series. The Nora soil has the profile described as representative of the Nora series.

Included with this complex in mapping were small areas of reddish loess of the Loveland formation. Also included in places bordering the Sandhills were small areas made up of stratified sandy layers.

This complex is suited to cultivation. Much of the acreage is cultivated or is in bromegrass, but some of the areas are seeded to native grass. Corn, sorghum, and alfalfa are the main crops grown, but most local crops can be grown. This complex is also suited to trees and to other less intensive uses.

The soils in this complex are subject to further erosion, and they have a low content of organic matter. Controlling erosion and maintaining tilth and fertility are the chief concerns of management. Capability unit IIIe-8, dryland, and IVe-1, irrigated; Limy Upland and Silty range sites; Silty to Clayey windbreak suitability group.

Crofton-Nora silt loams, 12 to 17 percent slopes, eroded (CND2).--These soils are well drained to somewhat excessively drained and are in the silty uplands. Most areas are 25 to 50 acres in size.

About 50 to 70 percent of this complex is Crofton soil, and about 25 to 45 percent is Nora soil. The Crofton soil occurs around the head of drainageways and on short side slopes. The Nora soil is on the base of long, smooth slopes between drainageways. Because of their contrasting colors, plowed areas of these soils have a patchy appearance (pl. I). Also in this complex are areas of Hobbs silt loam, 0 to 1 percent slopes, occasionally flooded, in narrow drainageways. All of the original surface layer of the Crofton soil, and about one-half of the original surface layer of the Nora soil have been removed by erosion.

Included with this complex in mapping were small areas of reddish loess of the Loveland formation. Also included in places bordering the Sandhills are small areas made up of stratified sandy layers.

This complex is suited to limited use for row crops. It is well suited, however, to trees and to other less intensive uses. Most of the acreage is cultivated or seeded to native grass. Corn, sorghum, alfalfa, and bromegrass are the main crops grown. Controlling erosion and maintaining tilth and fertility are the chief concerns of management. Capability unit IVe-8, dryland; Limy Upland and Silty range sites; Silty to Clayey windbreak suitability group.

Crofton-Nora silt loams, 17 to 30 percent slopes (CNE).--These soils occur around drainageways and on short side slopes in the silty uplands. The areas average 20 to 100 acres in size, but some areas are more than 100 acres.

About 50 to 70 percent of this complex is Crofton soil, and about 20 to 40 percent is Nora soil. The Crofton soil is on steep side slopes around the drainageways. The Nora soil occupies the smooth areas at the base of the slopes and between the drainageways. Also in this complex are areas of Hobbs silt loam, 0 to 1 percent slopes, occasionally flooded, in narrow drainageways. The Crofton and Nora soils each have the profile described as representative of their respective series.

Included with this complex in mapping were small areas of loessial hills and bluffs and small areas of reddish loess of the Loveland formation. Also included are small areas next to the Sandhills that have a fine sandy loam surface layer.

Steep slopes and rapid runoff make this complex unsuitable for cultivation. The areas are all in native grass used for range. The soils are also suited to trees and to other less intensive uses. If the cover of grass is removed, the soils in this complex are highly susceptible to erosion. Capability unit VIe-9, dryland; Limy Upland and Silty range sites; Silty to Clayey windbreak suitability group.

Elsmere Series

The Elsmere series consists of deep, somewhat poorly drained, nearly level to very gently sloping soils on terraces and in valleys in the sandhills. The water table fluctuates between a depth of 2 and 6 feet.

In a representative profile the surface layer is dark grayish-brown fine sand about 10 inches thick. The next layer, about 9 inches thick, is grayish-brown fine sand. Below this to a depth of 60 inches is fine sand. It is light yellowish brown in the upper 21 inches, pale brown in the next 14 inches, and grayish brown in the lower 6 inches.

Elsmere soils are seldom flooded. Runoff is slow, permeability is rapid, and available water capacity and natural fertility are low. Reaction is neutral.

Most areas of the Elsmere soils are in native grass and are used for range or meadow. If cultivated, these soils are subject to blowing. They

are often too wet in the spring to cultivate. Big bluestem, switchgrass and indiangrass are the main grasses on properly managed range.

Representative profile of Elsmere fine sand, in native grass, (0.15 mile west and 150 feet south of northeast corner and 275 feet southwest of gate in sec. 6, T. 21 N., R. 7 W.):

A11--0 to 4 inches, dark grayish-brown (10YR 4/2) fine sand, very dark brown (10YR 2/2) when moist; single grain; loose when dry and moist; neutral; abrupt, smooth boundary.

A12--4 to 10 inches, dark grayish-brown (10YR 4/2) fine sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry and moist; neutral; clear, wavy boundary.

AC--10 to 19 inches, grayish-brown (10YR 5/2) fine sand, dark grayish-brown (10YR 4/2) when moist; single grain; loose when dry and moist; neutral; abrupt, smooth boundary.

C1--19 to 40 inches, light yellowish-brown (2.5Y 6/4) fine sand, light olive brown (2.5Y 5/4) when moist; many brownish and dark-brown mottles; single grain; loose when dry and moist; neutral; clear, wavy boundary.

C2--40 to 54 inches, pale-brown (10YR 6/3) fine sand, grayish brown (10YR 5/2) when moist; a few dark-brown mottles; single grain; loose when dry and moist; neutral; abrupt, smooth boundary.

C3--54 to 60 inches, grayish-brown (2.5Y 5/2) fine sand, dark gray (2.5Y 4/0) when moist; a few dark-brown mottles; single grain; loose when dry and moist; neutral.

The A horizon ranges from very dark grayish brown to dark grayish brown in color, from 10 to 20 inches in thickness, and from loamy fine sand to find sand in texture. The AC horizon ranges from 6 to 10 inches in thickness. In places the C horizon has thin strata of very dark grayish brown and dark grayish brown colors.

Elsmere soils are next to Wann, Loup, and Valentine soils. They are fine sand throughout unlike Wann soils that are loam to fine sandy loam in the upper part. They have poorer drainage than Valentine soils and better drainage than Loup soils.

Elsmere fine sand (0 to 3 percent slopes) (Eb).--This soil occurs in areas that range from 10 to several hundred acres. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Gannett fine sandy loam and of Valentine fine sand, rolling. The Gannett soils are poorly drained and are in depressions. Valentine soils have steep undulating slopes and are excessively drained.

All the acreage of this soil is in native grass used for range and for native hay. This soil is not suited to cultivation, and it is subject to severe blowing if a cover of plants is not kept on the areas. In properly managed range the main grasses are big bluestem, indiangrass, and switchgrass. This soil is also suited to trees and is suitable for wildlife areas and for recreation sites. Capability unit VIw-5, dryland; Subirrigated range site; Moderately wet windbreak suitability group.

Elsmere loamy fine sand (0 to 3 percent slopes) (Ea).--This soil occurs in areas that range from 10 to several hundred acres. The surface layer is loamy fine sand that ranges from 7 to 18 inches in thickness but generally is 12 inches thick. In cultivated areas the surface layer is lighter colored than that in the profile described as representative of the series.

Included with this soil in mapping were small areas of Gannett fine sandy loam and of Valentine fine sand, rolling. The Gannett soil is poorly drained and is in depressions. The Valentine soil is on small sandy hummocks.

About 15 to 20 percent of the acreage of this Elsmere soil is cultivated. Most of the acreage, however, is used for range or native hay. The main grasses on properly managed range are big bluestem, indiangrass, switchgrass, and prairie cordgrass. Range on this soil requires management that controls soil blowing and that maintains the proper kinds of grass. Corn, sorghum, and alfalfa are the main crops grown, but small grains seldom are grown because of wetness early in spring. Soil blowing is the main concern of management in cultivated areas. This soil is also suited to wildlife, to recreation, and to trees. Capability unit IIIw-5, dryland; Subirrigated range site; Moderately Wet windbreak suitability group.

Fillmore Series

In the Fillmore series are deep, poorly drained, nearly level soils. These soils are in depressions on terraces and uplands.

In a representative profile the surface layer is about 20 inches thick. It is dark-gray silt loam in the upper 13 inches and gray silt loam in the lower 7 inches. The subsoil is about 38 inches thick. It is very dark grayish brown clay in the upper 11 inches, very dark gray clay in the next 17 inches, and dark grayish-brown silty clay in the last 10 inches. Below is light brownish-gray silty clay loam.

Permeability of these soils is slow, available water capacity is high, and fertility is medium. Runoff is slow to ponded. Reaction is neutral.

Most of the acreage of these soils is cultivated. Corn, sorghum, and alfalfa are the main crops grown, though most other local crops are suited. Occasionally runoff from higher areas ponds on these soils after heavy rains and crops are lost.

Representative profile of Fillmore silt loam in a cultivated field (50 feet north and 50 feet east of southwest corner of sec. 21, T. 21 N., R. 5 W.):

Ap--0 to 8 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A1--8 to 13 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, blocky structure that parts to weak, fine, granular; soft when dry, friable when moist; neutral; clear, wavy boundary.

A21--13 to 16 inches, gray (10YR 6/1) silt loam, dark gray (10YR 4/1) when moist; weak, medium, blocky structure that parts to weak, fine, granular; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A22--16 to 20 inches, gray (10YR 6/1) silt loam, gray (10YR 5/1) when moist; weak, coarse, platy structure; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

B21t--20 to 31 inches, very dark grayish-brown (10YR 3/2) clay, very dark brown (10YR 2/2) when moist; strong, coarse, blocky structure that parts to strong, medium, blocky; very hard when dry, very firm when moist; neutral; clear, wavy boundary.

B22t--31 to 48 inches, very dark gray (10YR 4/1) clay, very dark grayish brown (10YR 3/2) when moist; strong, coarse, blocky structure that parts to strong, fine, blocky; very hard when dry, very firm when moist; neutral; clear, wavy boundary.

B3--48 to 58 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium, blocky structure that parts to moderate, fine, blocky; hard when dry, firm when moist; neutral; clear, wavy boundary.

C--58 to 66 inches, light brownish-gray (10YR 6/2) silty clay loam; brown (10YR 5/3) when moist; massive; hard when dry, firm when moist; mildly alkaline.

The combined thickness of the Ap and A1 horizons ranges from 10 to 15 inches. The A2 horizon ranges from 3 to 8 inches in thickness, and the B horizon, from 36 to 42 inches. The C horizon is pale brown to light brownish gray.

Fillmore soils are next to Belfore and Moody soils on uplands and Hall soils on terraces. They are more poorly drained than all of these soils, and they have more clay in the B horizon.

Fillmore silt loam (0 to 1 percent slopes) (Fm).--This is the only Fillmore soil mapped in the county. It is in depressions on uplands and terraces in all except the Sandhills part of the county. The areas range from 5 to 80 acres in size, but they are dominantly 5 to 20 acres.

Included with this soil in mapping were small areas that are more frequently flooded than this soil. Also included were small areas of soil that have fine sand beneath the claypan.

Most of the acreage of this soil is cultivated. This soil generally is associated with Belfore, Hall, and Moody soils and generally is managed the same as those soils. Most local crops can be grown, but they are likely to be flooded by runoff from higher areas. If surface drainage is provided, this soil is well suited to cultivation. Land leveling and fertility maintenance are generally needed in irrigated areas. Capability unit IIIw-2, dryland, and IIs-2, irrigated; Clayey Overflow range site; Wet windbreak suitability group.

Gannett Series

The Gannett series consists of deep, poorly drained, nearly level soils in depressions on uplands. These soils formed in sand in wet areas in the Sandhills. The water table is at a depth of less than 2 feet most of the year and is at the surface part of the year.

In a representative profile the surface layer is very dark gray fine sandy loam about 7 inches thick. The next layer is very dark grayish-brown fine sandy loam about 3 inches thick. Below this is about 10 inches of light brownish-gray loamy fine sand, then about 10 inches of very dark gray silt loam, and then light brownish-gray loamy fine sand to a depth of 45 inches or more.

Gannett soils are neutral to moderately alkaline throughout. Runoff is very slow, and available water capacity is low. Permeability is rapid below the surface layer.

These soils are too wet for cultivation. They are used for native hay and range, and they make excellent wildlife habitat. When the range is in excellent condition, the native vegetation is cordgrass, reedgrass, and forbs.

Representative profile of Gannett fine sandy loam, in native grass, (20 feet south and 90 feet east of northwest corner, sec. 7, T. 22 N., R. 8 W.):

A1--0 to 7 inches, very dark gray (10YR 3/1) fine sandy loam, black (10YR 2/1) when moist; weak, fine, granular structure that breaks to weak, very fine, granular; slightly hard when dry, very friable when moist; neutral; clear, wavy boundary.

AC--7 to 10 inches, very dark grayish-brown (10Y 3/2) fine sandy loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; mildly alkaline; clear, wavy boundary.

C1--10 to 20 inches, light brownish-gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) when moist; single grain; loose when dry and moist; moderately alkaline; a few reddish-brown mottles; abrupt, smooth boundary.

Ab--20 to 30 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) when moist; neutral; many, common reddish-brown mottles; massive; hard when dry, friable when moist; clear, wavy boundary.

Cb--30 to 45 inches +, light brownish-gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) when moist; many, common reddish-brown mottles; single grain; loose when dry and moist; noncalcareous; moderately alkaline.

The A horizon ranges from loam to sandy loam in texture, and from 7 to 10 inches in thickness. The AC horizon ranges from 3 to 10 inches in thickness. In some places the C horizon is fine sand. The Ab horizon ranges from fine sandy loam to silt loam. Depth to the Ab horizon ranges from 20 to 40 inches.

Gannett soils are next to Valentine soils, and they are similar to Elsmere and Loup soils. They are more poorly drained than Valentine and Elsmere soils. Gannett soils occur in upland depressions unlike Loup soils, which are on bottom lands next to streams.

Gannett fine sandy loam (0 to 1 percent slopes) (Ga).--This is the only Gannett soil mapped in the county. It occurs in round saucerlike areas that range from 5 to 20 acres.

Included with this soil in mapping were small areas of Marsh and of Elsmere loamy fine sand.

This soil is too wet to cultivate. It is suited to native range and to hay. It is also suited to wildlife habitat and to recreational uses. In some years the forage cannot be harvested for hay because of wetness. Reedgrass, cordgrass, and sedges are the main vegetation. Capability unit Vw-1, dryland; Wetland range site; Wet windbreak suitability group.

Hall Series

The Hall series consists of deep, well-drained, nearly level to gently sloping soils. These soils are on terraces along the Cedar River, Beaver Creek, and other small streams. They formed in loess underlain by alluvium.

In a representative profile the surface layer is very dark grayish-brown silt loam about 13 inches thick. The subsoil is silty clay loam about 31 inches thick. It is dark grayish brown in the upper 9 inches, brown in the next 14 inches, and pale brown in the lower 8 inches. The substratum, to a depth of 60 inches, is pale-brown silt loam that is stratified in places and is calcareous at a depth of about 44 inches.

Hall soils are neutral in the surface layer and subsoil, and they are mildly alkaline and calcareous in the substratum. They have moderately slow permeability, high available water capacity and natural fertility, and they are easy to till. Runoff is slow.

Hall soils are suited to all locally grown crops, but corn and sorghum are the main crops grown. They are well suited to dryland and irrigation farming. Most of the acreage is cultivated, and a large part of it is irrigated with water from wells or streams. The remaining acreage is used for range or pasture.

Representative profile of Hall silt loam, 0 to 1 percent slopes, in an irrigated field (450 feet east and 290 feet north of southwest corner of sec. 34, T. 19 N., R. 5 W.):

Ap--0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A1--6 to 13 inches, very dark grayish-brown (10YR 3/2) heavy silt loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular; soft when dry, very friable when moist; neutral; clear, wavy boundary.

B1--13 to 22 inches, dark grayish-brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) when moist; moderate, medium, subangular blocky structure that parts to moderate, fine, subangular blocky; hard when dry, firm when moist; in places very dark brown (10YR 2/2) moist streaks in root channels; neutral; clear, wavy boundary.

B2t--22 to 36 inches, brown (10YR 5/3) silty clay loam, brown (10YR 4/3) when moist; strong, coarse, prismatic structure that parts to strong, medium, subangular blocky; hard when dry, firm when moist; neutral; peds have weak glazed appearance; clear, wavy boundary.

B3--36 to 44 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; moderate, medium, prismatic structure that parts to moderate, fine, subangular blocky; hard when dry, firm when moist; neutral; clear, wavy boundary.

C--44 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; mildly alkaline.

The A horizon ranges from 12 to 20 inches in thickness, and the B horizon from 18 to 32 inches. The C horizon generally is silt loam, but it ranges from silty clay loam to fine sandy loam at a depth below 60 inches. The color ranges from pale brown to yellowish brown. Very dark grayish-brown or very dark-brown layers, 1 to 6 inches thick, are common in many places.

Hall soils occur near Hord and Hobbs soils, and they are similar to Moody soils. They have more clay in the B horizon than Hord soils. They have a silty clay loam B horizon, unlike Hobbs soils, which lack a B horizon and generally are silt loam throughout. Hall soils have a thicker surface layer than Moody soils.

Hall silt loam, 0 to 1 percent slopes (Ha).--This soil occurs mostly in areas of 100 acres or more, but some areas range from 10 to 50 acres. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Hord silt loam, 0 to 1 percent slopes, and small areas of Fillmore silt loam. These areas are shown on the detailed map by a special symbol. Also included are areas of saline and alkali spots, and near the town of Primrose, an area of soil that has a lime layer in the subsoil at a depth between 18 and 24 inches.

Most areas of this soil are cultivated. All local crops are well suited, but corn, sorghum, and

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alfalfa are the main crops grown. The remaining acreage is used for range. Much of the acreage is irrigated by pumping water from deep wells or from creeks and many irrigated fields have been leveled. Maintaining tilth and fertility are needed for good growth of dryland or irrigated crops. In irrigated areas proper water management also is needed. When range is in excellent condition, big bluestem, indiangrass, switchgrass, needle-and-thread, and Canada wildrye are the main grasses. This soil is also suited to trees and to other less intensive uses. Capability unit I-1, dryland, and I-1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hall silt loam, 1 to 3 percent slopes (HaA).--This soil occurs in areas of 5 to several hundred acres. The surface layer is about 12 inches thick, and the subsoil is about 25 inches thick.

Included with this soil in mapping were small areas of Hord silt loam, 1 to 3 percent slopes. Also included were small areas of saline and alkali spots that are shown on the detailed soil map by a spot symbol.

Most of the acreage of this soil is cultivated. Corn, sorghum, and alfalfa arre the main crops, but this soil is suited to most locally grown crops. This soil is also suited to grass, to trees, and to other less intensive uses. It is suitable for irrigation, and about half of the acreage is irrigated. Most of the irrigation water is obtained from deep wells. In irrigated areas the main concerns are managing the water and maintaining tilth and fertility. Other concerns of management are controlling erosion and maintaining tilth. Land leveling generally is needed for proper water management. Capability unit IIe-1, dryland, and IIe-1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hall-Slickspots complex, 1 to 3 percent slopes (HSzA).--This complex is on terraces along Beaver Creek and the Cedar River. About 70 percent of the acreage is Hall soil, between depressions and knolls. The remaining 30 percent consists of Slickspots, which are in depressions or are on the higher knolls. The Hall part has a profile similar to that described for the Hall series. The Slickspots part has a dark-gray silt loam surface layer about 6 inches thick. The dark grayish-brown or brown subsoil, about 24 inches thick, ranges from silty clay loam to silty clay. It is calcareous and moderately alkaline in the lower part. The substratum is pale-brown or yellowish-brown loess. The Slickspots are irregular in shape and range from 10 to 100 feet across. They have formed as the result of poor surface drainage or of a high water table that left an accumulation of salt in the lower part of the subsoil when the water table dropped.

Included with this complex in mapping were small areas of gently sloping soil along drainageways.

Most of the acreage of this complex is irrigated and is used for crops, though some areas are used for range. This complex is also suited to less intensive uses. In cultivated areas both parts of this complex are managed as one unit. The Slickspots are difficult to till, and when dry they appear as light-colored, cloddy areas. They are plastic when wet. Crops do not grow so well on the Slickspots part of this complex as they do on the Hall part. Most locally grown crops are suited, but corn, sorghum, and alfalfa are the main crops. Land leveling helps to improve drainage. Applying fertilizer, including zinc on leveled areas, generally helps to improve and maintain fertility. Sulfur and gypsum can be used to help lower the alkalinity of the Slickspots. Capability unit IIIs-1, dryland, and IIs-1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hobbs Series

The Hobbs series consists of deep, well-drained, nearly level soils. These soils formed in alluvium on narrow bottom lands along intermittent drainageways and on wide bottom lands along major streams.

In a representative profile the texture is silt loam throughout. The surface layer is dark grayish brown and is about 18 inches thick. The next layer is very dark gray and is about 26 inches thick, and the material below is dark grayish brown and is about 16 inches thick.

Hobbs soils are neutral throughout. They have moderate permeability, high available water capacity and fertility, and are easy to till. Runoff is slow.

These soils are well suited to cultivated crops under dryland and irrigation farming. Nearly all of the acreage is cultivated, and much of it is irrigated. Most local crops are suited, but corn, sorghum, alfalfa, and bromegrass are the main crops grown. The remaining acreage is used for range or pasture.

Representative profile of Hobbs silt loam, 0 to 1 percent slopes, in a cultivated field, (210 feet south and 185 feet west of northeast corner of sec. 16, T. 22 N., R. 5 W.):

Ap--0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; neutral; abrupt, smooth boundary.

A1--6 to 18 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure that parts to weak, fine, granular; slightly hard when dry, very friable when moist; neutral; clear, wavy boundary.

Ab1--18 to 44 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) when moist; weak, fine, subangular blocky structure that parts to weak, fine, granular; soft when dry, very friable when moist; neutral; clear, wavy boundary.

Ab2--44 to 60 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2)

when moist; weak, fine, subangular blocky structure that parts to weak, fine, granular; soft when dry, very friable when moist; neutral.

The combined Ap and A1 horizons range from 18 to 24 inches in thickness. In upland drainageways the Ap horizon has a stratified layer that ranges from 6 to 12 inches in thickness. Here, the soils are flooded during and after heavy rains, but damage to crops generally is not severe. The A horizon generally is free of lime, but in places lime occurs in the light-colored overwash laid down recently on the areas. Below a depth of about 60 inches is brown silt loam.

Hobbs soils are near Hord, Lamo, and Leshara soils. They are more stratified than Hord soils and have a darker colored substratum. Hobbs soils are better drained than Lamo and Leshara soils.

Hobbs silt loam, 0 to 1 percent slopes (Hb).--This soil is on bottom lands along Plum Creek, Shell Creek, and other major streams in the county. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Hobbs silt loam, 0 to 1 percent slopes, occasionally flooded, and of Lamo silty clay loam.

Most of the acreage of this soil is cultivated, but a small acreage is used for range. This soil is suited to most local crops, but corn, sorghum, and alfalfa are the main crops grown. It is also suited to grass, to trees, and to other less intensive uses. Under dryland farming management is needed that includes use of crop residues and fertilizer. If this soil is irrigated, proper water management and fertilizer are needed, and in places land leveling also is needed. Capability unit I-1, dryland, and I-1, irrigated, Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hobbs silt loam, 0 to 1 percent slopes, occasionally flooded (2Hb).--This soil is in narrow upland drainageways or valleys throughout the silty uplands. Some areas are along Beaver Creek in the low bottom lands. On the average, the areas range from 5 to 25 acres. This soil generally is flooded after heavy rains, but the floodwater remains on the areas for only a short time.

Because this soil is occasionally flooded, its surface layer is more stratified than that in the profile described as representative of the series. It also contains layers of recent alluvium that range from 6 to 12 inches in thickness and from dark grayish brown to light brownish gray in color.

Included with this soil in mapping were small areas of Hord silt loam, terrace, 0 to 1 percent slopes, and areas that are frequently flooded.

Most of the acreage of this soil is cultivated, though some of the acreage is used for grassed waterways. This soil is suited to corn, sorghum, alfalfa, bromegrass, and native grass. Small grains seldom are planted because of the flood hazard. This soil is also suited to trees and to other less intensive uses. The main concerns of management are occasional flooding and maintaining tilth and fertility. Row direction, diversion terraces, and upstream water control help to control flooding. If practices that control water are used, this soil is suited to irrigation. Capability unit IIw-3, dryland, and I-1, irrigated; Silty Overflow range site; Moderately Wet windbreak suitability group.

Hord Series

The Hord series consists of deep, well-drained, nearly level to gently sloping soils. These soils are on uplands and terraces.

In a representative profile the surface layer is silt loam about 21 inches thick. The surface layer is dark grayish brown in the upper 6 inches and very dark grayish brown in the lower 15 inches. The subsoil is about 19 inches of grayish-brown silt loam. The substratum, to a depth of 60 inches, is pale brown silt loam.

The surface layer and subsoil of Hord soils are neutral in reaction, and the substratum is moderately alkaline and calcareous. Permeability is moderate, and available water capacity and fertility are high. Runoff is slow to medium. These soils are easy to work.

Hord soils are well suited to dryland and irrigation farming. Most of the acreage is cultivated, and much of it is irrigated. All crops commonly grown in the county are suited, but corn, sorghum, and alfalfa are the main crops.

Representative profile of Hord silt loam, terrace, 0 to 1 percent slopes (0.4 mile west and 200 feet south of northeast corner of sec. 4, T. 21 N., R. 7 W.):

Ap--0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A1--6 to 21 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, granular structure that parts to weak, fine, granular; soft when dry, very friable when moist; neutral; clear, wavy boundary.

B2--21 to 40 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular; slightly hard when dry; friable when moist; neutral; abrupt, smooth boundary.

Cca--40 to 60 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; moderately alkaline; many lime concretions in upper 10 inches, disseminated lime in lower part.

The A horizon ranges from 15 to 24 inches in thickness and from silt loam to very fine sandy loam

in texture. The B horizon ranges from 18 to 36 inches in thickness. It generally is silt loam, but in places it contains light silty clay loam layers. In upland areas, the C horizon is silt loam and has little stratification. On the terraces, the C horizon contains stratified layers of silt and in some areas loamy sand to fine sand below a depth of 40 inches. Dark buried layers are common in the C horizon.

Hord soils are next to Hall, Hobbs, and Moody soils. They have less clay in the B horizon than Hall soils, and they are less stratified and lighter colored in the lower part of the profile than Hobbs soils. Hord soils have a thicker A horizon and less clay in the B horizon than Moody soils.

Hord silt loam, 0 to 1 percent slopes (Hd).--This soil is on upland divides in areas that range from 10 to 300 acres. The surface layer ranges from very fine sandy loam to silt loam. The substratum is less stratified than that in the profile described as representative of the Hord series.

Included with this soil in mapping were small areas of Fillmore silt loam and of Hord silt loam, 1 to 3 percent slopes.

This soil is suited to both dryland and irrigation farming. It is suited to most local crops, but corn, sorghum, and alfalfa are the main crops grown. This soil is also suited to grass, to trees, and to other less intensive uses. Management that includes the use of crop residues and fertilizer is needed for good crop growth under dryland and irrigated farming. Preparing this soil for irrigation is more costly than on Hord silt loam, terrace, 0 to 1 percent slopes. Irrigation wells are much deeper and more careful water management generally is needed. Also, land leveling generally is required for proper water management. Capability unit I-1, dryland, and I-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hord silt loam, 1 to 3 percent slopes (HdA).--Most areas of this soil are on upland divides in areas that range from 10 to 200 acres, but a few areas are on colluvial slopes. The surface layer generally is silt loam, but it ranges from very fine sandy loam to light silty clay loam. The subsoil is about 24 inches thick.

Included with this soil in mapping were small depressional areas and small areas of Hord fine sandy loam on 1 to 3 percent slopes. Also included were small eroded areas on ridgetops.

This soil is well suited to both dryland and irrigated crops, and most of the acreage is cultivated. It is suited to most local crops, but corn, sorghum, and alfalfa are the main crops grown. This soil is also suited to grass, to trees, and to other less intensive uses. Preparing this soil for irrigation is more costly than on Hord silt loam, terrace, 1 to 3 percent slopes. Irrigation wells are much deeper, and more careful water management is needed. In some places deep cuts and fills are needed. Under dryland farming the main concerns of management are controlling erosion and maintaining tilth and fertility. Under irrigation the main concerns are maintenance of fertility, water management, and use of crop residues. Capability unit IIe-1, dryland, and IIe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hord silt loam, 3 to 7 percent slopes (HdB).--This soil is on colluvial slopes at the base of the uplands. It occurs in narrow areas between the uplands and terraces or between the uplands and the bottom lands. Most areas range from 10 to 50 acres in size, but some areas are larger.

The surface layer generally is silt loam, but it ranges from silt loam to light silty clay loam. The subsoil, about 18 inches thick, ranges from silt loam to light silty clay loam.

Included with this soil in mapping were small areas of Hall silt loam, 1 to 3 percent slopes; of Hord silt loam, 1 to 3 percent slopes; and of Hobbs silt loam, occasionally flooded. In many areas dark buried soils are common below a depth of 3 feet.

This soil is well suited to cultivated crops. Except for small areas in native grass, all of the acreage is cultivated. The main concerns of management are maintaining tilth and fertility and controlling water erosion. This soil is suited to most local crops, but corn, sorghum, and alfalfa are the main crops grown. This soil is also suited to grass, to trees, and to other less intensive uses. It is suitable for irrigation if irrigation water is properly managed, fertility levels raised, and good farming practices followed. In places land leveling is needed for gravity irrigation. Capability unit IIe-1, dryland, and IIIe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hord silt loam, terrace, 0 to 1 percent slopes (2Hd).--This soil is on terraces along Beaver Creek, the Cedar River, and other streams. The areas range from 10 to several hundred acres. This soil has the profile described as representative of the series.

Included with this soil in mapping were small areas of Hall silt loam, 0 to 1 percent slopes. Also included were small areas of Slickspots and small depressional areas that are shown on the detailed soil map by a spot symbol. Northwest of Albion is an included soil that has a sand substratum below a depth of 3 feet.

Most of the acreage of this soil is cultivated. This soil is well suited to most local crops, but corn, sorghum, and alfalfa are the main crops grown. It is also suited to grass, to trees, and to other less intensive uses. This soil is well suited to irrigation, and most of the acreage is irrigated by water from wells or by stream pumping. Plenty of water is available for irrigation, and good wells are generally easy to obtain. The depth of the wells is 100 to 150 feet. Under irrigation the main concerns are proper water management and fertility maintenance, though in some places land leveling is needed. Under dryland farming good management includes use of crop residues and fertilizer to help maintain fertility. Capability unit I-1, dryland, and I-1, irrigated, Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hord silt loam, terrace, 1 to 3 percent slopes (2HdA).--This soil is on terraces along Beaver Creek, the Cedar River, and other streams. It occurs in small areas adjacent to or near larger areas of Hord silt loam, terrace, 0 to 1 percent slopes. The subsoil is about 4 inches thinner than that in the profile described as representative of the series. Also, depth to lime is about 36 inches.

This soil is well suited to dryland or irrigation farming. Most of the acreage is cultivated, and much of it is irrigated. This soil is suited to most local crops, but corn, sorghum, and alfalfa are the main crops grown. It is also suited to grass, to trees, and to other less intensive uses. In dry farmed areas the main concerns of management are water erosion and maintaining tilth and fertility. Plenty of water is available for irrigation, and good wells are generally easy to obtain. The depth of the wells ranges from 120 to 150 feet. In irrigated areas the main concerns of management are the erosion hazard, water management, and maintaining fertility. Land leveling also is needed to help to control erosion and for proper water distribution. Capability unit IIe-1, dryland, and IIe-1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hord and Ortello fine sandy loams, 1 to 3 percent slopes (HO).--These soils are on stream terraces along the Cedar River and Beaver Creek and on colluvium at the base of upland slopes. Most of the areas range from 10 to 50 acres in size.

About 60 to 75 percent of this complex is Hord soil, and about 25 to 40 percent is Ortello soil. The Hord soil has a surface layer that ranges from 12 to 20 inches in thickness and is very dark grayish brown or dark grayish brown. In many places the plow layer is lighter colored and coarser textured than that in the profile described as representative of the Hord series. The Ortello soil has a profile like that described as representative of the Ortello series.

Nearly all of the acreage of this complex is cultivated, though small areas are in native grass. Some areas are irrigated. These soils are suited to all local crops, but corn, sorghum, and alfalfa are the main crops grown. The soils also are suited to other less intensive uses. Under irrigation the main concerns are water management and maintenance of fertility. Soil blowing is a hazard if a cover of vegetation is not kept on the areas. Capability unit IIe-3, dryland, and IIe-3, irrigated; Sandy range site; Sandy windbreak suitability group.

Inavale Series

The Inavale series consists of deep, somewhat excessively drained, nearly level to gently sloping soils. These soils are on bottom lands along Beaver Creek and the Cedar River.

In a representative profile the surface layer is dark grayish-brown loamy fine sand about 4 inches thick. The next layer is grayish-brown, loose loamy fine sand about 4 inches thick. Below this is about 22 inches of light brownish-gray fine sand, and then grayish-brown loamy sand to a depth of 60 inches.

Inavale soils are slightly acid in the surface layer and neutral to slightly acid below. They are seldom flooded. Permeability is rapid. Available water capacity, fertility, and organic-matter content are low. Runoff is slow.

These soils are suited to range and to crops. Most areas are used for range and for hay. Inavale soils are subject to soil blowing if a cover of plants is not kept on the areas. Sand bluestem, indiangrass, Canada wildrye, junegrass, and porcupine grass are the main grasses growing on properly managed rangeland.

Representative profile of an Inavale loamy fine sand (0.3 mile south and 0.35 mile east of northwest corner of sec. 8, T. 19 N., R. 8 W.):

A1--0 to 4 inches, dark grayish-brown (10YR 4/2) loamy fine sand; very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry and moist; slightly acid; abrupt, smooth boundary.

AC--4 to 8 inches, grayish-brown (10YR 5/2) loamy fine sand; very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry and moist; neutral; clear, wavy boundary.

C1--8 to 30 inches, light brownish-gray (10YR 6/2) fine sand; very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry and moist; neutral; clear, wavy boundary.

C2--30 to 60 inches, grayish-brown (10YR 5/2) loamy sand; dark grayish brown (10YR 4/2) when moist; massive; loose when dry and moist; neutral.

The A horizon ranges from 4 to 8 inches in thickness, from fine sandy loam to loamy fine sand in texture, and from dark grayish brown to grayish brown in color. The AC horizon is 2 to 6 inches thick. In many places the C horizon is fine sand below a depth of 30 inches.

Inavale soils are next to Cass and Wann soils. Inavale soils are sandy throughout, unlike Cass and Wann soils. They also are better drained than Wann soils.

Inavale soils (0 to 3 percent slopes) (Iz).--This mapping unit is on long, narrow, bottom lands along Beaver Creek and the Cedar River in areas that range from 5 to 35 acres. It has the profile described as representative of the series. The surface layer is mostly loamy fine sand, but in places it is fine sandy loam. Included in mapping were small areas of Inavale soils, wet.

These soils are used for range and for crops. Most of the acreage is in range. In properly managed range the main grasses are sand bluestem, indiangrass, Canada wildrye, junegrass, and porcupine grass. In many areas the vegetation is a mixture of trees and grass.

Inavale soils are droughty and are low in fertility. If they are cultivated, they are subject to

soil blowing. Corn, sorghum, and alfalfa are the main crops grown, but other locally grown crops are suited. These soils are also suited to trees and to use as wildlife areas. Capability unit IIIe-3, dryland; Sands range site; Sandy windbreak suitability group.

Inavale soils, wet (0 to 2 percent slopes) (2Iz).--These moderately wet soils are on bottom lands in channelled areas along the Cedar River and Beaver Creek. The areas are irregular in shape and range from 5 to 20 acres. The water table is at a depth of 2 to 6 feet.

These soils have a dark grayish-brown surface layer that ranges from 5 to 10 inches in thickness. It is dominantly fine sandy loam, but it ranges from loam to loamy fine sand. The surface layer is calcareous in the loam layers and neutral in the fine sandy loam and loamy fine sand layers. Below the surface layer is grayish-brown to gray loamy fine sand 3 to 6 inches thick. The substratum is neutral, light brownish-gray to pale-brown fine sand. It has many reddish-brown and black mottles.

Included in mapping with these soils were small areas of Loup loam.

Inavale soils, wet are used for range, for hay, and for crops. Most of the acreage is in native grass and scattered trees and is used for range. In cultivated areas the chief concerns of management are soil blowing and low fertility. The main grasses on properly managed range are bluestem, western wheatgrasses, and sedges. These soils make excellent wildlife areas. Capability unit IIIw-6, dryland; Subirrigated range site; Moderately Wet windbreak suitability group.

Lamo Series

In the Lamo series are deep, somewhat poorly drained, nearly level, calcareous soils. These soils are on bottom lands along Beaver Creek and the Cedar River. The water table is at a depth between 2 and 6 feet.

In a representative profile the surface layer is silty clay loam about 15 inches thick. It is very dark grayish brown in the upper 6 inches and very dark gray in the lower 9 inches. The next layer is gray silty clay loam about 9 inches thick. Below this is the silty clay loam substratum. The substratum is gray in the upper 13 inches, dark grayish brown in the next 5 inches, and gray below.

Lamo soils are calcareous and moderately alkaline throughout. Permeability is moderately slow. Available water capacity and natural fertility are high. Runoff is slow.

These soils are used for dryland and irrigated crops and for range and native hay. Corn and sorghum are the main crops grown, but other locally grown crops are suited. Big bluestem, switchgrass, indiangrass, and cordgrass are the main grasses in the range.

Representative profile of Lamo silty clay loam in a cultivated field, (150 feet north and 0.35 mile west of southeast corner, sec. 21, T. 19 N., R. 5 W.):

Ap--0 to 6 inches, very dark grayish-brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; calcareous; mildly alkaline; abrupt, smooth boundary.

A1--6 to 15 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; calcareous; moderately alkaline; clear, wavy boundary.

AC--15 to 24 inches, gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) when moist; weak, medium, prismatic structure that parts to weak, fine, subangular blocky; hard when dry, firm when moist; calcareous; moderately alkaline; disseminated lime; clear, wavy boundary.

C1--24 to 37 inches, gray (2.5Y 5/0) silty clay loam, very dark gray (2.5Y 3/0) when moist; moderate, medium, prismatic structure that parts to moderate, fine, subangular blocky; hard when dry, firm when moist; calcareous; moderately alkaline; many fine lime concretions; clear, wavy boundary.

C2--37 to 42 inches, dark grayish-brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) when moist; reddish and black mottles; strong, medium, prismatic structure that parts to moderate, medium, angular blocky; hard when dry, firm when moist; calcareous; many fine lime concretions; clear, wavy boundary.

C3--42 to 63 inches, gray (2.5Y 6/0) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; strong, medium, prismatic structure that parts to moderate, medium, angular blocky; hard when dry, firm when moist; calcareous; moderately alkaline; reddish and black mottles; many fine lime concretions.

The A and AC horizons, together, range from 24 to 30 inches in thickness. The C horizon generally is silty clay loam, but it is silty clay in places.

Lamo soils are similar to Leshara and Wann soils in drainage and are next to Hobbs soils. Lamo soils have more clay throughout the profile than Leshara and Wann soils. They are more poorly drained than Hobbs soils.

Lamo silty clay loam (0 to 1 percent slopes) (Lb).--This is the only Lamo soil mapped in the county. Included in mapping were small areas of saline and alkali soils.

This soil is well suited to dryland or irrigated crops. Most of the acreage is cultivated, but about 10 percent of it is used for native hay. About 50 percent of the acreage is irrigated. Because of

wetness early in spring, this soil generally is used for corn, sorghum, and alfalfa. The main concern of management is the moderately high water table that causes excessive wetness in some years but may benefit crops in dry years. Drainage is needed in some areas. In irrigated areas land leveling generally is needed for good water management. Maintenance of fertility is also needed. Bluestem, indiangrass, switchgrass, cordgrass, and Canada wildrye, are the main native grasses in range that is properly managed. Capability unit IIw-4, dryland, and IIw-4, irrigated; Subirrigated range site; Moderately Wet windbreak suitability group.

Leshara Series

The Leshara series consists of deep, somewhat poorly drained, nearly level, calcareous soils that formed in alluvium. These soils are on bottom lands along the Cedar River and Beaver Creek.

In a representative profile the surface layer is very dark grayish-brown silt loam about 13 inches thick. The next layer is dark grayish-brown silt loam about 5 inches thick. Below this is a substratum that has 3 distinct layers. The upper layer is 16 inches of brown silt loam; the next layer is about 14 inches of grayish-brown very fine sandy loam; and the layer below is dark grayish-brown very fine sandy loam. Thin stratified material occurs throughout the substratum. Many lime concretions are evident.

Leshara soils are mildly to moderately alkaline throughout. Permeability is moderate. Available water capacity and natural fertility are high. These soils are easily worked.

Leshara soils are well suited to dryland and irrigation farming. Most areas are cultivated, but some areas are in native grass. Corn, sorghum, and alfalfa are the main crops grown. Because of wetness early in spring, small grains seldom are grown. Crops on these soils respond well to irrigation. The water table causes excessive wetness in some years, but in many years it provides subirrigation that benefits crops. Areas in permanent grass produce good growth of big bluestem, switchgrass, indiangrass, and prairie cordgrass.

Representative profile of Leshara silt loam, 180 feet east of railroad in a cultivated field, (0.4 mile south and 0.2 mile east of northwest corner of sec. 22, T. 18 N., R. 7 W.):

Ap--0 to 8 inches, very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular; hard when dry, very friable when moist; calcareous; mildly alkaline; abrupt, smooth boundary.

A1--8 to 13 inches, very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular; hard when dry, very friable when moist; calcareous; mildly alkaline; abrupt, smooth boundary.

AC--13 to 18 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular; hard when dry, very friable when moist; calcareous; mildly alkaline; clear, wavy boundary.

C1--18 to 34 inches, brown (10YR 5/3) silt loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular; slightly hard when dry, very friable when moist; calcareous; mildly alkaline, clear, wavy boundary.

C2--34 to 48 inches, grayish-brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; a few reddish-brown mottles; massive; slightly hard when dry, very friable when moist; calcareous; mildly alkaline; clear, smooth boundary.

Cba--48 to 60 inches, dark grayish-brown (10YR 4/2) very fine sandy loam, very dark grayish brown (10YR 3/2) when moist; many, distinct, reddish-brown and black mottles; massive; slightly hard when dry, very friable when moist; calcareous; moderately alkaline.

The A horizon ranges from 12 to 18 inches in thickness and from dark grayish brown to very dark gray in color. The AC horizon is 4 to 6 inches thick. It ranges from grayish brown to dark grayish brown. The C horizon ranges from dark grayish brown to gray and brown in color and from loam to light silty clay loam in texture. Dark buried layers are common. In many places coarse textured layers occur below a depth of 60 inches.

Leshara soils are next to Lamo, Wann, and Cass soils. They have a lower content of clay throughout the profile than Lamo soils. The C horizon is loamy in Leshara soils and sandy in Wann and Cass soils. Leshara soils are more poorly drained than Cass soils.

Leshara silt loam (0 to 1 percent slopes) (Le).--This is the only Leshara soil mapped in the county. It occurs in areas that range from 15 to 50 acres.

Included with this soil in mapping were small areas of saline and alkali soils that are shown on the detailed soil map by a spot symbol. Also included are a few small areas that have a surface layer of fine sandy loam or loam.

Leshara silt loam is suited to cultivated crops. Most of the acreage is cultivated, but about 25 percent is used for native range or hay. This soil is suitable for irrigation, but in places land leveling, drainage, and maintenance of fertility are needed for best results. Corn, sorghum, and alfalfa are the main crops grown. Because of wetness early in spring, small grains are not well suited. The main concern of management is the moderately high water table that causes excessive wetness in some years but benefits crops in dry years. If adequate outlets are available, some areas can be drained. Bluestem, indiangrass, switchgrass, cordgrass, and Canada wildrye are the main native grasses in range

that is properly managed. Capability unit IIw-4, dryland, and IIw-4, irrigated; Subirrigated range site; Moderately Wet windbreak suitability group.

Loess Hills and Bluffs

Loess hills and bluffs (Lh) consists of very steep loessial material in rough broken areas. The largest area is south of Primrose and south of the Cedar River. Another area is southeast of St. Edward and north of Beaver Creek. Other small areas also are in the county.

Most of the Loess hills and bluffs has very steep slopes that are catstepped. The texture is mostly silt loam. Scattered areas of sand occur, mostly on the lower slopes or near the base of the slopes. On the smoother rolling lower slopes are small areas of Nora and Crofton soils that are too small or scattered to be mapped separately.

Loess hills and bluffs is suitable for grazing and for use as wildlife and recreation areas. It has a cover mainly of tall and short grasses, though trees grow in scattered areas on this land type. Capability unit VIIe-1, dryland; Thin Loess range site; Silty to Clayey windbreak suitability group.

Loretto Series

In the Loretto series are deep, well-drained, gently sloping to moderately sloping soils. These soils formed in loess on uplands.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 18 inches thick. The subsoil is grayish-brown loam in the upper 4 inches and brown silt loam in the lower 20 inches. Below this is pale-brown silt loam to a depth of 60 inches.

Loretto soils range from slightly acid to neutral in the surface layer, are mildly alkaline in the subsoil, and moderately alkaline in the substratum. Permeability is moderate, available water capacity is moderate to high, and natural fertility is medium. Runoff is medium.

Loretto soils are suited to cultivation, though in places soil blowing and water erosion are hazards. Most of the acreage is cultivated, and the rest is in native grass. Corn, sorghum, and alfalfa are the main crops grown; but other local crops are suited. Mid and tall grasses are the main native grasses.

Representative profile of Loretto fine sandy loam, 3 to 7 percent slopes, eroded, in a cultivated field, (2,330 feet north and 160 feet east of southwest corner of sec. 21, T. 21 N., R. 8 W.):

Ap--0 to 5 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure that parts to single grain; loose when dry, very friable when moist; slightly acid; clear, smooth boundary.

A1--5 to 18 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular; soft when dry, very friable when moist; neutral; clear, wavy boundary.

B1--18 to 22 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, subangular blocky; soft when dry, very friable when moist; neutral; clear, smooth boundary.

B2--22 to 42 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) when moist; weak, medium, subangular blocky structure that parts to weak, fine, subangular blocky; slightly hard, when dry, friable when moist; mildly alkaline; gradual, wavy boundary.

Cca--42 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure or massive; soft when dry; very friable when moist; calcareous; moderately alkaline; a few distinct iron stains.

The A horizon ranges from 12 to 20 inches in thickness and from loam to sandy loam in texture. The Ap horizon is loamy sand in places in cultivated fields. The B1 horizon ranges from 0 to 6 inches in thickness, and the B2 horizon, from 20 to 30 inches. The C horizon has small lime pebbles in the upper part and disseminated lime below. Depth to lime ranges from 36 to 48 inches.

Loretto soils are associated with Moody, Hord, Thurman, and Nora soils. Loretto soils have more sand in the A horizon and less clay in the B horizon than Moody soils. They have more sand in the surface layer than Hord soils. Loretto soils have a medium textured B horizon, unlike Thurman soils, which are coarse textured throughout. They are coarser textured in the A and B1 horizons than the Nora soils.

Loretto fine sandy loam, 0 to 3 percent slopes, eroded (LvA2).--This soil is on sandy and silty uplands in patches of 5 to 25 acres that are irregular in shape. Because of soil blowing the plow layer ranges from fine sandy loam to loamy sand.

Included with this soil in mapping were small areas of Loretto loam on 3 to 7 percent slopes. Also included were small areas of Thurman loamy fine sand, silty substratum, 0 to 3 percent slopes.

Most of the acreage of this Loretto soil is cultivated, but a small acreage is in native grass. Corn, sorghum, and alfalfa are the main crops, but this soil is suited to most crops commonly grown. This soil is also suited to trees and to other less intensive uses. Little of the acreage is irrigated, though this soil is suitable for irrigation. Under good management sand bluestem, sand lovegrass, switchgrass, and indiangrass are the main grasses. The main concerns of management are controlling soil blowing and maintaining the content of organic matter, tilth, and fertility. Capability unit IIe-3, dryland, and IIe-3, irrigated; Sandy range site; Sandy windbreak suitability group.

Loretto fine sandy loam, 3 to 7 percent slopes, eroded (LvB2).--This soil is on sandy and silty uplands in areas of 5 to 30 acres. It has the profile described as representative of the series. Because of soil blowing the plow layer ranges from fine sandy loam to loamy sand. The plow layer is thinnest on the knobs and thickest in the swales.

Included with this soil in mapping were small areas of Loretto fine sandy loam, 0 to 3 percent slopes, eroded.

Most of the acreage of this Loretto soil is cultivated, but a small acreage is in native grass. Corn, sorghum, and alfalfa are the main crops, but this soil is suited to other locally grown crops. This soil is also suited to trees and to other less intensive uses. Under good management sand bluestem, sand lovegrass, switchgrass, and indiangrass are the main grasses. The main concerns of management are controlling soil blowing and water erosion and maintaining the content of organic matter, tilth, and fertility. Capability unit IIe-3, dryland, and IIIe-3, irrigated; Sandy range site; Sandy windbreak suitability group.

Loretto loam, 3 to 7 percent slopes, eroded (LlB2).--This soil is on sandy and silty uplands. It occurs mostly in long narrow patches that range from 5 to 15 acres in size, but some areas are as much as several hundred acres.

The surface layer generally is about 8 inches thick, but it ranges from 6 to 10 inches in thickness. It is dark grayish brown. About one-fourth of the original surface layer has been removed by erosion.

Included with this soil in mapping were small areas of Loretto fine sandy loam, 3 to 7 percent slopes, eroded.

Most of the acreage of this Loretto soil is cultivated, but small areas are in native grass. Corn, sorghum, and alfalfa are the main crops, though this soil is suited to most local crops. This soil is also suited to trees and to other less intensive uses. The main concerns of management are controlling water erosion and maintaining tilth and fertility. Capability unit IIe-1, dryland, and IIIe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Loretto-Nora fine sandy loams, 7 to 12 percent slopes, eroded (LNC2).--These soils are on sandy and silty uplands. About 50 to 65 percent of this complex is made up of Loretto soil, and about 30 to 45 percent is made up of Nora soil. The rest is made up of Thurman loamy fine sand, 7 to 12 percent slopes, and of Hobbs silt loam, occasionally flooded.

The surface layer in the Loretto part of this complex is mainly fine sandy loam, but it ranges from loam to loamy fine sand. It is 3 to 6 inches thinner than that in the profile described as representative of the Loretto series. In the Nora part of this complex, the surface layer is mainly fine sandy loam but ranges from loam to loamy fine sand. It ranges from 7 to 18 inches in thickness, but it generally is about 12 inches thick. Lime is at a depth between 20 and 30 inches.

About 65 percent of the acreage of this complex is cultivated, and about 35 percent is in native grass. In cultivated areas the main concerns of management are controlling water erosion and soil blowing and maintaining tilth and fertility.

This soil is suited to most local crops, but corn, sorghum, and alfalfa are the main crops grown. Good range management helps to keep the proper kinds of grass in areas left in native grass. This complex is also suited to trees and to other less intensive uses. Capability unit IIIe-3, dryland; Sandy range site; Sandy windbreak suitability group.

Loup Series

The Loup series consists of deep, poorly drained, nearly level soils along Beaver Creek and the Cedar River. In these soils the water table is at a depth of 2 feet for most of the year.

In a representative profile the surface layer is dark-gray loam about 10 inches thick. The next layer is light brownish-gray, loose loamy fine sand about 2 inches thick. Below this is 14 inches of light brownish-gray fine sand, and then grayish-brown fine sand to a depth of 48 inches.

Loup soils are mildly alkaline in the surface layer and transitional layer, and mildly alkaline to neutral in the substratum. Permeability is rapid, and available water capacity is low. Runoff is very slow.

Loup soils are too wet for cultivation and are used for range and hay. They make excellent habitat for wildlife. Prairie cordgrass, reedgrass, and sedges are the main vegetation.

Representative profile of Loup loam (125 feet east and 200 feet north of Beaver Creek and 0.3 mile south of northeast corner of sec. 7, T. 22 N., R. 8 W.):

A1--0 to 10 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) when moist; weak, fine, subangular blocky structure that parts to weak, fine, granular; very friable when moist; calcareous; abrupt, smooth boundary.

AC--10 to 12 inches, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; many reddish-brown mottles; single grain; loose when moist; mildly alkaline; clear, wavy boundary.

C1--12 to 26 inches, light brownish-gray (2.5Y 6/2) fine sand, dark grayish brown (2.5Y 4/2) when moist; many reddish-brown and black mottles; single grain; loose when moist; mildly alkaline; gradual, wavy boundary.

C2--26 to 48 inches, grayish-brown (2.5Y 5/2) fine sand, very dark grayish brown (2.5Y 3/2) when moist; single grain; loose when moist; neutral.

The A horizon ranges from 10 to 14 inches in thickness. The AC horizon ranges from 2 to 4 inches in thickness. Dark-colored layers are common in the C horizon.

Loup soils are next to Elsmere and Wann soils, and they are more poorly drained than those soils. Depth to sandy material is less in Loup soils than in Wann soils.

Loup loam (0 to 1 percent slopes) (Lm).--This is the only Loup soil mapped in the county. It occupies low lying areas along Beaver Creek and the Cedar River, but the largest area is next to Beaver Creek.

Included with this soil in mapping were small areas of Marsh and of Wet alluvial land.

This soil is too wet for cultivated crops. It is used for native hay and range, but in some years the hay cannot be harvested because of wetness. This soil supports a good cover of grass, and reedgrass, prairie cordgrass, and sedges are the main plants. Some areas, however, have a cover of grass and trees. Good management is needed to maintain the desired kinds of grass in range. This soil is well suited to use as wildlife and recreation areas. Capability unit Vw-1, dryland; Wetland range site; Wet windbreak suitability group.

Marsh

Marsh (0 to 1 percent slopes) (M) consists of nearly level areas along Beaver Creek and the Cedar River. The areas are frequently flooded, and water stands on the surface for most of the time.

The soil material ranges from silt loam to sand, but it is dominantly sand. In much of the area, a layer of organic matter that ranges from thin to thick covers the soil material.

In summer the vegetation on Marsh consists of a thick stand of cattails, rushes, and sedges. In wet seasons water covers the areas. Marsh is suited to use as wildlife and recreation areas. Capability unit VIIIw-3, dryland; not used as range; Nonplantable windbreak suitability group.

Moody Series

In the Moody series are deep, well-drained, very gently sloping to gently sloping soils. These soils are on uplands and terraces.

In a representative profile the surface layer is dark grayish-brown silty clay loam about 8 inches thick. The subsoil is hard silty clay loam about 28 inches thick. It is brown in the upper 19 inches and pale brown in the lower 9 inches. The substratum consists of several feet of pale-brown, calcareous silt loam. It has many lime concretions in the upper part, but the lime becomes disseminated in the lower part.

Moody soils are neutral in the surface layer and subsoil, and they are mildly to moderately alkaline in the substratum. Permeability is moderately slow, available water capacity and natural fertility are high. Runoff is medium, and these soils are susceptible to erosion.

These soils are well suited to cultivated crops, and most of the acreage is cultivated. They are suited to irrigation. Corn and sorghum are the main crops, but all crops commonly grown in the county are suited. In cultivated areas practices are needed for the control of erosion. The acreage that is not cultivated is used for range. Mid and tall grasses are the native vegetation.

Representative profile of Moody silty clay loam, 3 to 7 percent slopes, eroded, in a cultivated field (150 feet south and 0.1 mile east of northwest corner of sec. 9, T. 22 N., R. 6 W.):

Ap--0 to 8 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, friable when moist; neutral; abrupt, smooth boundary.

B1--8 to 11 inches, brown (10YR 5/3) silty clay loam, brown (10YR 4/3) when moist; weak, medium, prismatic structure that breaks to weak, fine, subangular blocky; slightly hard when dry, friable when moist; neutral; clear, wavy boundary.

B2--11 to 27 inches, brown (10YR 5/3) silty clay loam, brown (10YR 4/3) when moist; moderate, medium, prismatic structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; a few clay films; clear, wavy boundary.

B3--27 to 36 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 4/3) when moist; weak, coarse, prismatic structure that parts to weak, fine, subangular blocky; slightly hard when dry, firm when moist; mildly alkaline; clear, wavy boundary.

Cca--36 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; soft when dry; very friable when moist; calcareous; moderately alkaline; many fine to medium lime concretions.

The A horizon ranges from 7 to 12 inches in thickness in areas under native grass, and from 4 to 10 inches in thickness in areas that are cultivated. The B horizon ranges from 26 to 36 inches in thickness. Depth to the lime layer ranges from 30 to 50 inches. The C horizon ranges from pale brown to brown and yellowish brown.

Moody soils are next to Belfore and Nora soils. They have a thinner B horizon and are not so deep to lime as Belfore soils. Moody soils have more clay in the B horizon and are deeper to lime than Nora soils.

Moody silty clay loam, 1 to 3 percent slopes (MoA).--This soil is on upland divides. The areas are irregular in shape and range from about 25 to 100 acres in size.

The surface layer is about 4 inches thicker than that in the profile described as representative of the series. The subsoil is about 32 inches thick, and depth to lime is about 46 inches.

Included with this soil in mapping were small areas of Fillmore silt loam. Most of these areas are shown on the detailed soil map by a spot symbol. Also included were small areas of Belfore silt loam, 0 to 1 percent slopes.

This Moody soil is well suited to cultivated crops, and most of the acreage is cultivated. A small acreage is in native grass. Corn, sorghum, and alfalfa are the main crops, but this soil is suited to most locally grown crops. The main concerns of management are controlling water erosion and maintaining tilth and fertility. This soil is also suited to grass, to trees, and to other less intensive uses. It is suitable for irrigation, but some areas are too irregular in shape to irrigate efficiently. In places in irrigated areas, land leveling is needed for proper water management, and fertility needs to be maintained. Capability unit IIe-1, dryland, and IIe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Moody silty clay loam, 1 to 3 percent slopes, eroded (MoA2).--This soil is on upland ridgetops in long narrow areas of 5 to 25 acres. In places plowing has mixed material from the upper part of the subsoil with the remaining surface layer, and the soil has a patchy appearance of light- and dark-colored areas. The subsoil is about 24 inches thick.

Included with this soil in mapping were small areas of Moody silty clay loam, 1 to 3 percent slopes. Also included were small areas of Moody silty clay loam, 3 to 7 percent slopes, eroded.

Most areas of this Moody soil are cultivated. This soil is suited to irrigation, but most areas are too small or irregular in shape to irrigate by gravity. The main concerns of management are controlling erosion and maintaining tilth and fertility. In irrigated areas, water must be properly managed. Corn, sorghum, and alfalfa are the main crops, but this soil is suited to most locally grown crops. This soil is also suited to trees and to other less intensive uses. Capability unit IIe-1, dryland, and IIe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Moody silty clay loam, 3 to 7 percent slopes, eroded (MoB2).--This soil is on upland ridgetops and terraces in areas that are irregular in shape and size. It has the profile described as representative of the series. When left in native grass, the surface layer ranges from 7 to 12 inches in thickness.

Included with this soil in mapping were small areas of Moody silty clay loam, 1 to 3 percent slopes, eroded. These areas generally are shown on the detailed soil map by a special symbol. Also included were small areas of severely eroded soil.

This soil is well suited to cultivation, though it is subject to water erosion. Most of the acreage is cultivated, but a small acreage is in native grass. Some areas are irrigated. The main concerns of management are controlling erosion and maintaining tilth and fertility. In irrigated areas, water must be properly managed and fertility maintained. Corn, sorghum, and alfalfa are the main crops, but this soil is suited to most locally grown crops. This soil is also suited to grass, to trees, and to other less intensive uses. Capability unit IIe-1, dryland, and IIIe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Nora Series

The Nora series consists of deep, well-drained, gently sloping to strongly sloping soils. These soils formed in loess on uplands.

In a representative profile the surface layer is dark grayish-brown silt loam about 7 inches thick (pl. I). The subsoil is slightly hard silt loam about 22 inches thick and has lime at a depth of about 16 inches. It is dark grayish brown in the upper 4 inches and brown or yellowish brown in the lower 18 inches. Below this is light yellowish-brown silt loam loess. It has many lime concretions in the upper part but the lime is disseminated in the lower part.

Nora soils are neutral in the surface layer and in the upper part of the subsoil, but they are moderately alkaline in the lower part of the subsoil and in the substratum. Permeability is moderate, and available water capacity and natural fertility are high. These soils are easy to till. If these soils are cultivated, they are subject to water erosion. Runoff is medium to rapid.

Nora soils are suited to cultivation, and most areas are cultivated. About 10 percent of the acreage is in native grass. Corn, sorghum, and alfalfa are the main crops grown, but all local crops are suited. Mid and tall grasses are the main vegetation in range.

Representative profile of Nora silt loam, 7 to 12 percent slopes, eroded, in a cultivated field, (350 feet south and 450 feet east of northwest corner of sec. 17, T. 20 N., R. 5 W.):

Ap--0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; neutral; abrupt, smooth boundary.

B1--7 to 11 inches, dark grayish-brown (10YR 4/2) heavy silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, subangular blocky; slightly hard when dry, friable when moist; neutral; clear, wavy boundary.

B21--11 to 16 inches, brown (10YR 5/3) silt loam, brown (10YR 4/3) when moist; weak, coarse, prismatic structure that parts to weak, medium, subangular blocky; slightly hard when dry, friable when moist; neutral, clear, wavy boundary.

B22ca--16 to 29 inches, yellowish-brown (10YR 5/4) silt loam, dark yellowish brown (10YR 4/4) when moist; weak, coarse, prismatic structure that parts to weak, medium, subangular blocky; slightly hard when dry, friable when moist; calcareous; moderately alkaline; many lime concretions; clear, wavy boundary.

C1ca--29 to 45 inches, light yellowish-brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; calcareous; moderately alkaline; many lime concretions; clear, gradual boundary.

C2ca--45 to 60 inches, light yellowish-brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; calcareous; moderately alkaline; lime concretions are less than in C1ca horizon and are more disseminated.

The A horizon ranges from 7 to 12 inches in thickness in areas under native grass, and from 4 to 8 inches in thickness in areas that are cultivated. The B horizon ranges from 16 to 24 inches in thickness, and from silt loam to light silty clay loam. Depth to lime ranges from 12 to 30 inches, but it averages 16 to 20 inches. The C horizon ranges from pale brown to brown or light yellowish-brown. Where Nora soils are adjacent to Valentine and Thurman soils, strata of loam and very fine sandy loam are present in some areas.

Nora soils are associated with Crofton, Moody, Hobbs, and Loretto soils. They have a thicker A horizon than Crofton soils and are deeper to lime. They have less clay in the B horizon than Moody soils and are shallower to lime. Nora soils have a thinner A horizon than Hobbs soils and are shallower to lime. They have finer textured upper horizons than Loretto soils.

Nora silt loam, 7 to 12 percent slopes (NoC).--This soil is on the silty uplands in areas that range from 10 to several hundred acres in size. They are on long smooth slopes around upland drainageways. The surface layer is 7 to 12 inches thick. Depth to lime is 18 to 24 inches.

Included with this soil in mapping were small areas of Crofton silt loam, 7 to 17 percent slopes, and of Moody silty clay loam, 3 to 7 percent slopes, eroded. Also included were small areas of Hobbs silt loam, 0 to 1 percent slopes, occasionally flooded. In areas adjacent to the Sandhills, are some areas of soil that contain strata of sand.

This Nora soil is suited to cultivation, but all areas are in native grass. Maintaining the desired species of grass is the chief concern of management. If the cover of grass is removed, this soil is susceptible to water erosion. Using good management that includes rotation grazing, deferred grazing, and proper stocking helps to maintain a proper cover of grass. Big bluestem, little bluestem, indiangrass, switchgrass, and Canada wildrye are the main grasses in range that is well managed. This soil is also suited to trees and to other less intensive uses. Capability unit IIIe-1, dryland, and IVe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Nora silt loam, 7 to 12 percent slopes, eroded (NoC2).--This soil occupies smooth slopes around drainageways in the silty uplands. The areas range from 5 to several hundred acres in size. This soil has the profile described as representative for the series. About one-half of its original surface layer has been removed through water erosion.

Included with this soil in mapping were small areas of Crofton silt loam, 7 to 17 percent slopes, eroded, and of Moody silty clay loam, 3 to 7 percent slopes, eroded. Also included were small areas of Hobbs silt loam, occasionally flooded. In areas adjacent to the Sandhills, are areas of soil that contain strata of sand. These areas erode more readily than other areas of this soil.

This Nora soil is suited to cultivation, and most of the acreage is cultivated. Some areas have been seeded to native grass or to tame grass. This soil is subject to water erosion, and intensive management is needed for good crop growth. Corn, sorghum, and alfalfa are the main crops, but this soil is suited to most local crops. In many places bromegrass is planted with alfalfa for hay and pasture. This soil is suited to sprinkler irrigation, but careful water management and fertility maintenance are needed. It also is suited to grass, to trees, and to other less intensive uses. Capability unit IIIe-1, dryland, and IVe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Nora-Crofton silt loams, 12 to 17 percent slopes (NCD).--These soils occur around drainageways in the silty uplands. The areas are irregular in shape and average about 5 to 25 acres in size.

About 60 to 75 percent of this complex is Nora soil, and about 20 to 35 percent is Crofton soil. Each of these soils has a profile like that described as representative of their respective series.

Included with this complex in mapping were small areas of Hobbs silt loam, 0 to 1 percent slopes, occasionally flooded. This included soil makes up about 5 percent of the mapped areas of this complex.

This complex is suited to limited use for row crops, but it is all in native grass. If cultivated, these soils are highly susceptible to water erosion. The main concern of management is controlling erosion, and this can be done by keeping a vigorous stand of grass on the areas. Rotation grazing, deferred grazing, and proper stocking help to maintain the desired kinds of grasses. Big bluestem, indiangrass, and switchgrass are the main grasses under good management. This complex is also suited to trees and to other less intensive uses. Capability unit IVe-1, dryland; Silty and Limy Upland range sites; Silty to Clayey windbreak suitability group.

Nora-Moody complex, 3 to 7 percent slopes, eroded (NMB2).--These soils are on ridgetops in the silty

uplands. Most of the areas are long and narrow and average 10 to 20 acres in size.

About 60 to 70 percent of this complex is Nora soil, and about 30 to 40 percent is Moody soil. The Nora soil has a surface layer of silt loam, and the Moody soil has a surface layer of silty clay loam.

Each of these soils has a profile similar to the one described as representative of their respective series. From 1/2 to 3/4 of the original surface layer has been removed by water erosion. In many places the brown or dark-brown subsoil is exposed when the soils are plowed. In some areas lime concretions are on the surface.

This complex is suited to cultivation, and most of the acreage is cultivated. Fertility is low. Water erosion is the chief concern of management. This soil is suited to most local crops, but corn, sorghum, and alfalfa are the main crops grown. The soils are suited to sprinkler irrigation, but good water management is needed. They are also suited to grass, to trees, and to other less intensive uses. Capability unit IIIe-8, dryland, and IIIe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Ortello Series

In the Ortello series are deep, well-drained, very gently sloping soils. These soils are on terraces along Beaver Creek.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 15 inches thick. The next layer is grayish-brown, soft fine sandy loam about 7 inches thick. The substratum has two contrasting layers. The upper 9 inches is pale-brown loamy fine sand. The lower part to a depth of 60 inches is silt loam that is brown in the upper 9 inches and pale brown below.

Ortello soils are slightly acid to neutral in the surface layer and in the layer just below. They are neutral in the sandy substratum and mildly to moderately alkaline in the silty substratum. Permeability is moderately rapid to a depth of 31 inches and moderate below. Available water capacity is moderate to high, and natural fertility is medium. Runoff is slow.

Ortello soils are suited to cultivated crops and to range. Most of the acreage is cultivated. All local crops are suited, but corn, sorghum, and alfalfa are the main crops grown. Mid and tall grasses are the native vegetation.

Representative profile of an Ortello fine sandy loam in a cultivated field in an area of Hord and Ortello fine sandy loams, 1 to 3 percent slopes (100 feet south and 0.15 mile east of northwest corner of sec. 21, T. 20 N., R. 6 W.):

Ap--0 to 7 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; slightly acid; abrupt, smooth boundary.

A1--7 to 15 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; neutral; clear, wavy boundary.

AC--15 to 22 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure that parts to weak, medium, subangular blocky; soft when dry, very friable when moist; neutral; clear, wavy boundary.

C--22 to 31 inches, pale-brown (10YR 6/3) loamy fine sand, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure that parts to single grain; soft when dry, friable when moist; neutral; abrupt, smooth boundary.

IIB--31 to 40 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) when moist; weak, medium, subangular blocky structure that parts to weak, fine, subangular blocky; slightly hard when dry, friable when moist; mildly alkaline; clear, wavy boundary.

IIC--40 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; calcareous; moderately alkaline.

The A horizon ranges from 12 to 18 inches in thickness. In cultivated areas the Ap horizon ranges from fine sandy loam to loamy sand. The AC horizon ranges from 4 to 8 inches in thickness, and the C horizon ranges from 8 to 14 inches in thickness. Depth to the IIB horizon is 30 to 40 inches.

Ortello series in Boone County have a siltier substratum than is typical for the series, but this difference does not alter their usefulness and behavior.

Ortello soils are mapped only in a complex with Hord soils, and they are similar to Loretto soils. Ortello soils are more sandy in the upper 30 inches than Hord soils. Depth to the silt loam layers is greater in Ortello soils than in Loretto soils.

Sandy Alluvial Land

Sandy alluvial land (0 to 2 percent slopes) (Sx) consists of mixed sandy material laid down by water on flood plains. Most areas are along Beaver Creek and the Cedar River, but some small areas are along intermittent streams in the Sandhills. This land type consists of stratified loamy sand and fine sand that contains little organic matter and shows slight development. Most areas are nearly level, but many areas are channelled and hummocky. The water table is at a depth of 6 to 10 feet.

Sandy alluvial land is not suitable for cultivation. It is used for native and wooded pasture. Little vegetation grows on areas where material has recently been deposited. Capability unit VIw-1, dryland; Sandy Lowland range site; Very Sandy windbreak suitability group.

Silty Alluvial Land

Silty alluvial land (0 to 2 percent slopes) (Sy) consists of frequently flooded, medium-textured, mixed material. It occurs along larger intermittent streams that are deeply entrenched. Most areas are along Bogus Creek, Plum Creek, Timber Creek, and other small streams. These areas are flooded several times each year, but the flood water recedes after a few hours. The water table is at a depth below 8 feet. Meandering creek channels bordered by abrupt slopes are common.

The soil material consists of both light- and dark-colored silt loam and silty clay loam sediment washed from surrounding hills. Thin strata of sand occur in many places.

Most of Silty alluvial land is in native grass, trees, and annual weeds. Cultivation is difficult or is not feasible because of flooding and inaccessibility of the areas to machinery. The areas are used for pasture and to provide shelter for livestock. They are suitable for use as wildlife and recreation areas. Capability unit VIw-1, dryland; Silty Overflow range site; Moderately Wet windbreak suitability group.

Thurman Series

The Thurman series consists of deep, somewhat excessively drained, nearly level to moderately undulating soils on uplands and terraces. These soils formed in wind-laid sand.

In a representative profile the surface layer is loamy fine sand about 17 inches thick. It is dark gray in the upper 7 inches and very dark grayish brown in the lower 10 inches. The next layer is brown, loose loamy fine sand about 6 inches thick. Below this is pale-brown loamy fine sand that grades to fine sand at a depth of about 60 inches.

Thurman soils are slightly acid in the surface layer and neutral in the layer below and in the substratum. Permeability is rapid, available water capacity is low, and fertility is medium. Runoff is slow.

These soils are well suited to native grass, and they are suited to cultivated crops. They are used for range and for growing crops. If these soils are cultivated, careful management is needed to control soil blowing and to maintain tilth and fertility. These soils generally are deficient in lime and phosphorus. Corn, sorghum, alfalfa, and vetch are the main crops, but this soil is suited to most local crops. Areas in native grass have a cover of mid and tall grasses.

Representative profile of Thurman loamy fine sand, 3 to 7 percent slopes, in a cultivated field (2,565 feet north and 0.1 mile west of southeast corner of sec. 20, T. 21 N., R. 8 W.):

Ap--0 to 7 inches, dark-gray (10YR 4/1) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry and moist; slightly acid; abrupt, smooth boundary.

A1--7 to 17 inches, very dark grayish-brown (10YR 3/2) loamy fine sand, very dark brown (10YR 2/2) when moist; single grain; loose when dry and moist; slightly acid; clear, wavy boundary.

AC--17 to 23 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) when moist; single grain; loose when dry and moist; neutral; clear, wavy boundary.

C--23 to 60 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) when moist; single grain; loose when dry and moist; neutral.

The A horizon ranges from 10 to 20 inches in thickness. In many places in cultivated areas, the Ap horizon is grayish-brown, winnowed loamy sand. The AC horizon ranges from 6 to 10 inches in thickness. The C horizon is commonly loamy fine sand, but it is fine sand in many places.

Thurman soils occur next to Valentine, Loretto, and Hord soils. They have a thicker and darker colored A horizon than Valentine soils. Thurman soils are sandy throughout the profile, unlike Loretto and Hord soils, which are loamy in the subsoil and substratum.

Thurman loamy fine sand, 0 to 3 percent slopes (ThA).--This soil is on low ridges and hummocks in the sandy uplands. The areas are irregular in shape and range from 5 to 50 acres in size. In cultivated areas the plow layer ranges from loamy fine sand to loamy sand, and from dark grayish brown to brown. The surface layer is thinner on the knobs and thicker in the swales.

Included with this soil in mapping were small areas of Thurman loamy fine sand, 3 to 7 percent slopes. Also included are areas of a soil that has layers of silt at a depth below 4 feet.

This Thurman soil is suited to range and to cultivated crops. About 50 percent of the acreage is cultivated. Careful management is needed to control soil blowing and to maintain tilth and fertility. Using crop residues, stripcropping, and planting field windbreaks are ways of controlling soil blowing and maintaining tilth and fertility.

Corn, sorghum, alfalfa, rye, and vetch are the main crops grown, but this soil is suited to most local crops. Little of the acreage is irrigated, but this soil is suited to irrigation. Where irrigated careful management is needed to improve and maintain fertility. Areas in native grass have a cover of mid and tall grasses. Proper range management helps to maintain a cover of grass and to keep the desired kinds of grass in the range. This soil is also suited to trees and to other less intensive uses. Capability unit IIIe-5, dryland, and IVe-5, irrigated; Sandy range site; Sandy windbreak suitability group.

Thurman loamy fine sand, 3 to 7 percent slopes (ThB).--This soil is on ridges and in pockets in the sandy uplands that range from 5 to 50 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were small areas of Thurman loamy fine sand, 0 to 3 percent

slopes. Also included are areas of soil that has layers of silt at a depth below 4 feet.

This Thurman soil is suited to range and to cultivated crops. About 50 percent of the acreage is cultivated, and the rest is in range. In cultivated areas this soil is subject to blowing if the vegetation is removed.

Corn, sorghum, alfalfa, rye, and vetch are the main crops grown, though this soil is suited to most local crops. Areas that are in native grass have a cover of mid and tall grasses. Proper range management helps to maintain a cover of grass and to keep the desired kinds of grass in the range. This soil is also suited to trees and to other less intensive uses. Capability unit IIIe-5, dryland; Sandy range site; Sandy windbreak suitability group.

Thurman loamy fine sand, 7 to 12 percent slopes (ThC).--This soil occurs in the sandy uplands. The areas range from 10 to 200 acres in size.

The surface layer ranges from 10 to 18 inches in thickness. It is thinnest on the ridges and thickest in the swales. In areas cultivated, the plow layer ranges from loamy fine sand to loamy sand in texture and from dark grayish brown to grayish brown in color. If the cover of vegetation is removed, this soil is subject to blowing.

Included with this soil in mapping were small areas of Valentine loamy fine sand, undulating. Also included are areas that are severely eroded as the result of soil blowing.

This soil is suited to native range. The slope and the hazard of soil blowing make the soil poorly suited to cultivated crops. About 70 percent of the acreage is in native grass, and the cultivated areas generally are seeded to alfalfa and bromegrass. Areas not cultivated are best kept in grass. Such grasses as sand bluestem, switchgrass, sand lovegrass, indiangrass, junegrass, and lead plant are the main native plants. Good range management is needed to maintain the proper kinds of grass in the range. This soil is also suited to trees and to other less intensive uses. Capability unit VIe-5, dryland; Sands range site; Very Sandy windbreak suitability group.

Thurman loamy fine sand, silty substratum, 0 to 3 percent slopes (2ThA).--This soil is on sandy uplands in areas that range from 5 to 40 acres in size.

This soil has a silt loam substratum at a depth between 30 and 40 inches, but its profile otherwise is similar to the one described as representative of the series. The substratum is grayish brown to light yellowish brown.

Included with this soil in mapping were small areas of Thurman loamy fine sand, 0 to 3 percent slopes. Also included were small areas of Loretto fine sandy loam, 0 to 3 percent slopes, eroded.

This soil is suited to cultivation. It is used for range and for cultivated crops. If the cover of vegetation is removed, this soil is subject to soil blowing. Corn, sorghum, and alfalfa are the main crops grown, but this soil is suited to most local crops. This soil is also suited to irrigation and to trees and to other less intensive uses. Crops on this soil generally grow better than on other Thurman soils because the silty substratum holds more water within the reach of most crop roots. Tall and medium grasses are the main native plants. Good range management helps to control soil blowing and to maintain the desired kinds of grass. Capability unit IIIe-5, dryland, and IVe-5, irrigated; Sandy range site; Sandy windbreak suitability group.

Thurman loamy fine sand, terrace, 0 to 3 percent slopes (5ThA).--This soil is on terraces along Beaver Creek and the Cedar River. The areas average from 5 to 50 acres in size.

The surface layer is 4 to 6 inches thicker than that in the profile described as representative of the series. It ranges from very dark grayish brown to grayish brown. In cultivated areas the plow layer is loamy fine sand or loamy sand. The water table is at a depth between 6 and 10 feet.

Included with this soil in mapping were small areas of soil that has a subsoil of fine sandy loam. Also included are small areas of soil that has a layer of silt below a depth of 4 feet.

This soil is suited to cultivation. It is used for cultivated crops and for range. Corn, sorghum, and alfalfa are the main crops, but this soil is suited to most local crops. Alfalfa generally grows better on this soil than on Thurman loamy fine sand, 0 to 3 percent slopes, because their roots can reach the water table. In cultivated areas this soil is subject to soil blowing if the cover of vegetation is removed. This soil is suited to gravity or sprinkler irrigation. Where irrigated fertility needs to be maintained. Areas in native grass have a cover of tall and mid grasses. Proper range management helps to maintain a cover of grass and to keep the desired kinds of grass in the range. This soil is also suited to trees and to other less intensive uses. Capability unit IIIe-5, dryland, and IVe-5, irrigated; Sandy Lowland range site; Sandy windbreak suitability group.

Thurman-Valentine complex, 0 to 3 percent slopes (TV).--These soils are in valleys in the Sandhills and around the edge of the Sandhills. The areas range from 15 to 40 acres in size. These soils are severely eroded by wind that blows the sand from the high knobs and deposits it in lower areas. The hazard of further soil blowing is high.

About 60 to 75 percent of this complex is Thurman soil, and about 20 to 35 percent is Valentine soil. The Thurman soil has a surface layer that is loamy sand or fine sand in the upper part and very dark grayish-brown fine sand or fine sand below. The surface layer ranges from 10 to 18 inches in thickness.

The Valentine soil has a thin surface layer of pale-brown fine sand that has lost all of its organic matter. The remaining 5 percent of this complex consists of Blown-out land.

Most areas of these soils have been cultivated at some time. Much of the acreage is now seeded to native grass, which is the best use for these soils. The grass helps to stabilize the soils and produces good forage. Keeping a cover of grass on the areas helps to control soil blowing. Also, tillage needs

to be kept to a minimum and all crop residues returned to the soils. Capability unit VIe-5, dryland; Sandy range site; Very Sandy windbreak suitability group.

Valentine Series

The Valentine series consists of deep, excessively drained, gently sloping to strongly sloping soils. These soils formed in sand laid down by wind on terraces and uplands.

In a representative profile the surface layer is grayish-brown fine sand about 4 inches thick. The next layer is pale-brown fine sand about 3 inches thick. The substratum to a depth of 60 inches is light yellowish-brown fine sand.

Valentine soils are slightly acid to medium acid throughout. Permeability is rapid, and available water capacity and fertility are low. Runoff is slow.

Most areas of the Valentine soils are in native range, but a few small areas are cultivated or in trees. These soils are too sandy and unstable for successful cultivation. If the plant cover is removed, soil blowing is a serious hazard. These soils are better suited to range and to use as wildlife and recreation areas than to other uses. Mid and tall grasses are the native vegetation. Sand bluestem, switchgrass, indiangrass, lovegrass, and Canada wildrye are the main grasses in range that is properly managed.

Representative profile of a Valentine fine sand, in native grass (180 feet east and 0.3 mile south of northwest corner of sec. 13, T. 22 N., R. 8 W.):

A1--0 to 4 inches, grayish-brown (10YR 5/2) fine sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry and moist; slightly acid; abrupt, smooth boundary.

AC--4 to 7 inches, pale-brown (10YR 6/3) fine sand, dark brown (10YR 4/3) when moist; single grain; loose when dry and moist; slightly acid; clear, wavy boundary.

C--7 to 60 inches, light yellowish-brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) when moist; single grain; loose when dry and moist; slightly acid; a few dark-brown (10YR 4/3) mottles.

The A horizon generally is grayish brown, but in places it is dark grayish brown. It ranges from 3 to 7 inches in thickness and from fine sand to loamy fine sand in texture. The C horizon ranges from light yellowish brown to pale brown.

Valentine soils occur next to Thurman and Elsmere soils. They have a thinner A horizon and a sandier profile than Thurman soils. Their A horizon is thinner than that in Elsmere soils, and they are better drained.

Valentine fine sand, rolling (VaC).--This soil is mainly on uplands in the Sandhills, but some small areas are on terraces along the Cedar River. It has the profile described as representative of the series.

Included with this soil in mapping were small blowouts and small areas of Gannett fine sandy loam. Also included were some steep areas next to Beaver Creek.

This Valentine soil is suitable for range and for use as wildlife and recreation areas. All of the acreage is in native grass used for grazing or hay. Indiangrass, sand bluestem, lovegrass, Canada wildrye, and switchgrass are the main mid and tall grasses if the range is in excellent condition. Under good range management that includes proper stocking, deferred grazing, rotation grazing, and proper distribution of salt and water a good cover of grass can be maintained. If the cover of vegetation is removed, the hazard of soil blowing is serious. Capability unit VIe-5, dryland; Sands range site; Very Sandy windbreak suitability group.

Valentine loamy fine sand, undulating (Vb).--This soil occurs in long narrow areas and in small areas that are irregular in shape. The areas are in the sandy uplands, and they are mostly low and hummocky.

The surface layer is loamy fine sand about 6 inches thick.

Included with this soil in mapping were small blowouts and small areas of Valentine fine sand, rolling. Also included were small areas of Thurman loamy fine sand, 7 to 12 percent slopes.

This soil is suitable only for range, for use as wildlife and recreation areas, and for other less intensive uses. Most of the acreage is now in native grass used for hay and for grazing. Mid and tall grasses, such as indiangrass, bluestem, lovegrass, prairie junegrass, and switchgrass, are the main grasses in range that is in excellent condition. Under good range management that includes proper stocking, deferred grazing, rotation grazing, and proper distribution of salt and water a good cover of grass can be maintained. If the vegetative cover is removed, the hazard of soil blowing is serious. Capability unit VIe-5, dryland; Sands range site; Very Sandy windbreak suitability group.

Wann Series

The Wann series consists of deep, somewhat poorly drained, nearly level soils on bottom lands along Beaver Creek and the Cedar River. These soils have a limy surface layer. The water table fluctuates between a depth of 2 and 6 feet. In places these soils are subject to overflow.

In a representative profile the surface layer is loam or very fine sandy loam about 17 inches thick. It is dark gray in the upper 5 inches and dark grayish brown in the lower 12 inches. The next layer is dark grayish-brown, soft fine sandy loam about 5 inches thick. The substratum is grayish-brown to dark grayish-brown loamy fine sand in the upper 21 inches and grades to light brownish-gray fine sand at a depth of 43 inches.

Wann soils are calcareous and moderately alkaline above the water table. Permeability is moderately rapid, available water capacity is moderate, and fertility is medium to high. These soils are easy to work. Runoff is slow.

These soils are suited to cultivated crops and to range. A small acreage is irrigated. In some seasons wetness limits crop growth, but in drier seasons the water table benefits crops. Wann soils produce excellent stands of mid and tall grasses.

Representative profile of Wann loam (25 feet south and 0.1 mile east of northwest corner of sec. 4, T. 21 N., R. 7 W.):

Ap--0 to 5 inches, dark-gray (10YR 4/1) loam or very fine sandy loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; calcareous; moderately alkaline; abrupt, smooth boundary.

A1--5 to 17 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; calcareous; moderately alkaline; clear, wavy boundary.

AC--17 to 22 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; calcareous; moderately alkaline; clear, wavy boundary.

C1--22 to 33 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry, and moist; calcareous; moderately alkaline; clear, wavy boundary.

C2--33 to 43 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry and moist; calcareous; moderately alkaline; clear, wavy boundary.

C3--43 to 60 inches, light brownish-gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) when moist; many black (10YR 2/1) mottles; single grain; loose when dry and moist; many root pores; neutral.

The A horizon ranges from 10 to 18 inches in thickness, and from loam to fine sandy loam in texture. The AC horizon ranges from 5 to 14 inches in thickness, and from dark grayish brown to dark gray in color. Depth to the layer of fine sand ranges from 40 to 50 inches.

The Wann soils in Boone county have sand higher in the C horizon than is typical for the series, but this difference does not alter their usefulness and behavior.

Wann soils are next to Cass, Loup, Elsmere, and Leshara soils. They are more poorly drained and occupy lower positions in the landscape than Cass soils. They are better drained than Loup soils. Wann soils are loamy in the upper part and sandy below, unlike Elsmere soils that are sandy throughout and Leshara soils that are loamy throughout.

Wann loam (0 to 1 percent slopes) (Wm).--This is the only Wann soil mapped in the county. It occurs along Beaver Creek and the Cedar River. The areas are long and narrow, generally are next to the river or creek, and average from 10 to 25 acres in size.

Included with this soil in mapping were small areas of Elsmere loamy fine sand. Also included were small areas of Inavale soils, wet, and of Leshara silt loam.

This soil is suitable for cultivation, and about 50 percent of the acreage is cultivated. Some areas are irrigated. In some seasons wetness limits crop growth, but in dry seasons the water table benefits crops. Small grains are seldom grown because of the wetness early in spring. In some places drainage is beneficial. If this soil is gravity irrigated, land leveling generally is needed for proper distribution of water. Fertility needs to be maintained. Corn, sorghum, and alfalfa are the main crops grown, but other crops common in the county are suited. About 50 percent of the acreage is used for range or native hay, and excellent stands of grasses are obtained under proper management. Big bluestem, indiangrass, switchgrass, prairie cordgrass, and Canada wildrye are the main grasses grown in range that is in excellent condition. Capability unit IIw-4, dryland, and IIw-4, irrigated; Subirrigated range site; Moderately Wet windbreak suitability group.

Wet Alluvial Land

Wet alluvial land (0 to 1 percent slopes) (Wx) consists of very poorly drained, low lying areas on bottom lands along Beaver Creek and the Cedar River. It occurs in swales and in old channels next to the streams. The water table generally is at a depth of less than 2 feet, but it is above the surface for part of the year.

The soil material varies widely in texture and in color. In a typical area the surface layer is very dark gray or very dark grayish brown and ranges from 12 to 18 inches in thickness. It generally is silt loam, but it ranges from silty clay loam to very fine sandy loam. The next layer is gray stratified silt loam to fine sandy loam that ranges from 0 to 6 inches in thickness. The substratum is silt loam to silty clay loam in the upper part to loamy sand or fine sand in the lower part. It is stratified and mottled.

Wet alluvial land is calcareous above the water table. It is used for pasture and hay. Sedges, prairie cordgrass, cattails, and other plants that tolerate wetness are the dominant vegetation. This land is too wet to cultivate. Many areas have cottonwood and willow trees growing on them. Wet alluvial land is suitable for use as wildlife and recreation areas. Capability unit Vw-1, dryland; Wetland range site; Wet windbreak suitability group.

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MANAGEMENT OF THE SOILS FOR CROPS[2/]

This section contains an explanation of the system of grouping soils into capability units according to their suitability for cultivated crops and pasture; a discussion of the management of the soils in the county, by capability units; and a table showing predicted yields of the principal crops.

The chief concerns in managing the soils of Boone County are maintaining soil structure and tilth, providing protection from soil blowing and water erosion, and controlling weeds, insects, and diseases. Use of conservation cropping systems is one of the most common methods of controlling erosion. A conservation cropping system is one that includes a high proportion of close-growing crops. When conservation cropping systems are used, other practices that can be used for erosion control are using all crop residue, keeping tillage to a minimum, terracing, farming on the contour, using grassed waterways, and adding fertilizer.

A suitable cropping system includes grasses and legumes that supply long-lasting residue. The cropping system varies, depending on the soil and its capability for farm crops. For example, a suitable cropping system for Crofton silt loam, 7 to 17 percent slopes, eroded, includes a large proportion of grasses and legumes, but one for Hord silt loam, 1 to 3 percent slopes needs only a small proportion of these crops. A good supply of long-lasting residue can be obtained if such crops as sorghum and corn are grown in the cropping system.

Leaving all crop residue on the soils helps to protect them from blowing and from water erosion and assures that a supply of organic matter is returned to the soils. Best results are obtained if the crop residue is left on the surface as much of the year as possible and then is incorporated into the soil surface when the seedbed is prepared. This is especially true on such soils as the Loretto and Thurman and the Thurman-Valentine complex, 0 to 3 percent slopes. Control of grazing by livestock is needed to prevent removal of all of the crop residue.

Soils must be worked to prepare a seedbed, to control weeds, and to provide a suitable place for plants to grow. Excess tillage, however, breaks down soil structure. If row crops are grown, the till-plant method provides for minimum tillage and is better suited than other tillage methods to the soils of Boone County. Grasses can be established by drilling into a cover of milo stubble; no other seedbed preparation is needed.

Both level and gradient terraces are used in Boone County. The level terrace is an earth embankment or a ridge and channel constructed across the slope at suitable spacing and with no grade. The ends of the level terrace are closed so that as much water as possible is held in the soil. Examples of soils suited to the construction of level terraces are the Nora silt loams. The gradient terrace is an earth embankment or a ridge and channel constructed across the slope at suitable spacing and with an acceptable grade. This terrace is built so that one end is slightly lower than the other. In this way water drains to a lower area, preferably a grassed waterway. The Hall and Moody soils are suited to the construction of gradient terraces.

Where large quantities of water need to be diverted from certain areas, a terrace called a diversion is used. A diversion is a channel with a supporting ridge on the lower side constructed across the slope. A diversion generally is planted to grass and grassed waterways are provided to carry away excess runoff.

On the sloping soils contour farming helps to control soil blowing and water erosion. In areas that are farmed on the contour, terraces serve as guidelines for tillage and planting operations done across the slope. In this way the furrows, rows, ridges, and wheel tracks are nearly level. Terraces and contour farming supplement each other.

Grassed waterways are natural drainageways that have been smoothed, leveled, and seeded to grass to protect them from erosion. They need to be fertilized and maintained to help control erosion. Grassed waterways can be used to produce hay or grass seed and to furnish cover for upland game birds.

In Boone County fields that are dryfarmed need less fertilizer than fields that are irrigated. Crops on most of the soils respond if farm manure or chemical fertilizer is added. Fertilizer should be applied in the kinds and amounts indicated by the results of soil tests. In general, nitrogen is needed on all soils in the county and phosphorus is needed on most of the soils. The supply of potassium in the soils is sufficient for crop needs. Zinc is required in areas that have been leveled or that are severely eroded, and other trace elements are needed on some of the soils. Soils that have a slightly acid or medium acid surface layer or subsoil require additions of lime and phosphorus.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils

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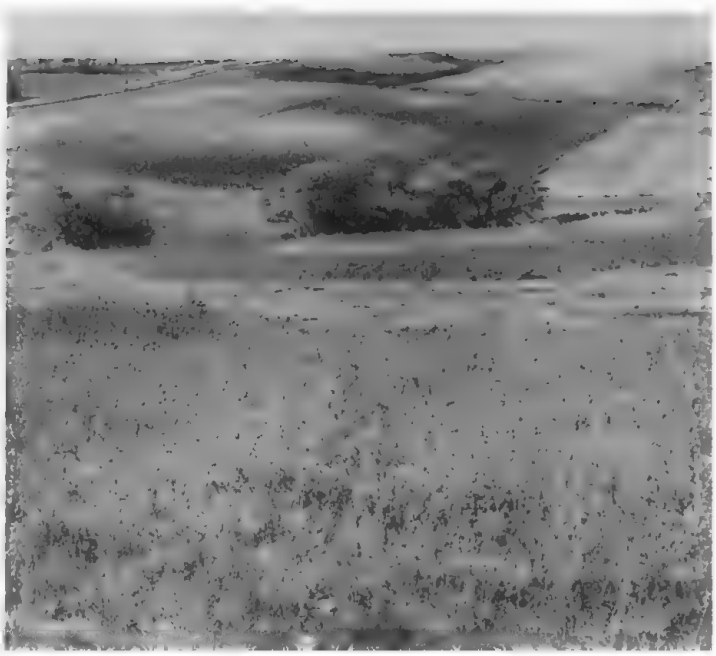
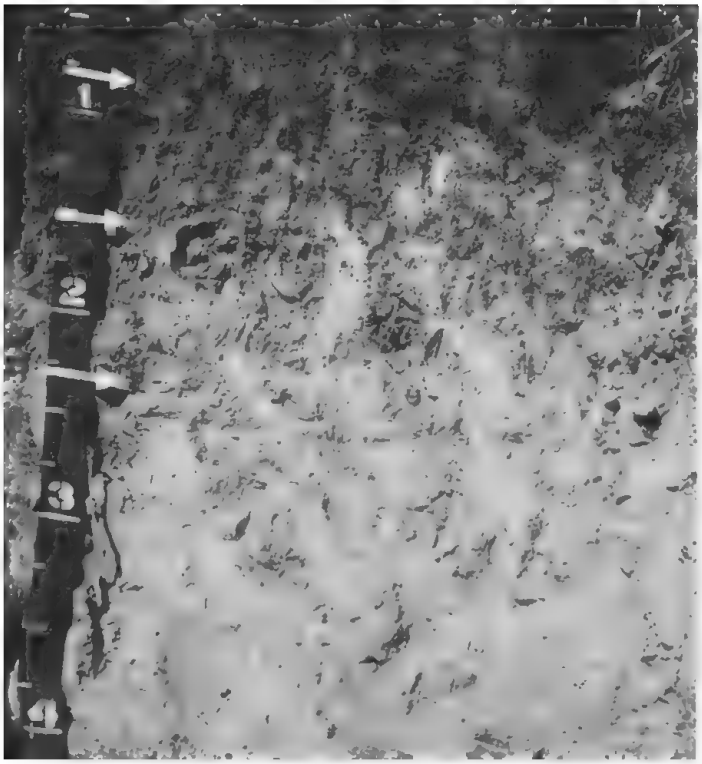
[2/] By E. O. PETERSON, conservation agronomist, Soil Conservation Service.

Blown-out land that has been smoothed in preparation for renovation.



Light areas are Crofton silt loam, and dark areas are Nora silt loam.



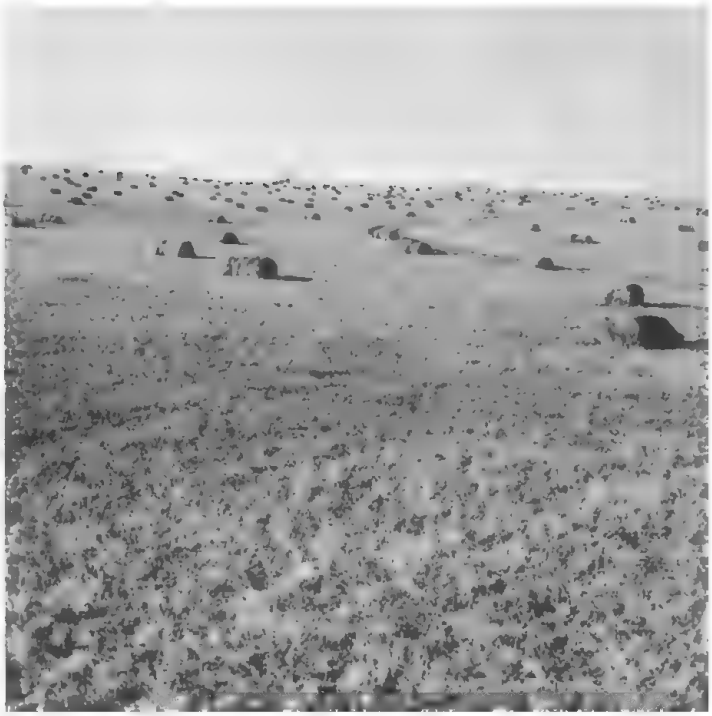
Typical profile of a Nora silt loam.

Terraces and waterways on Nora silt loam.

PLATE II

Loess hills and bluffs.

Grain sorghum; mixture of suited native grasses to be planted in stubble.



Native meadow on Thurman loamy fine sand, 3 to 7 percent slopes.

when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or engineering.

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, e, w, s, or c, to the class numeral, for example, IIe. The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, but not in Boone County, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by w, s, and c, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-3 or IIIe-5. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Capability units are generally identified by numbers assigned locally and are part of a statewide system. Not all the units in the system are represented in Boone County; consequently, the capability units described in this survey are not numbered consecutively.

Both dryland farming and irrigated farming are practiced in Boone County, and each capability unit is designated as either irrigated or dryland. Soils that are farmed partly under irrigation and partly as dryland are in two capability units. Fillmore silt loam, for example, is in capability unit IIIw-2 dryland, and IIs-2, irrigated.

Dryland Capability Units

In the following pages, the capability units, or groups of soils similar in management requirements for dryfarming are described; some limitations are given; and suitable management is discussed. The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all soils of a given series appear in the unit. The names of all the soils in any given capability unit can be found in the "Guide to Mapping Units" at the back of this survey.

Capability Unit I-1, Dryland

This unit consists of deep, well-drained, nearly level soils on uplands, terraces, and bottom lands. These soils are in the Belfore, Cass, Hall, Hobbs, and Hord series. They have a surface layer of loam to silt loam and a subsoil of fine sandy loam, silt loam, and silty clay loam. Available water capacity is high in all except the Cass soils, which have low to moderate available water capacity. Permeability of the subsoil is moderately rapid to moderately slow. These soils are easy to till.

The main concern of management is maintaining fertility. Fertility can generally be maintained by returning all crop residues to the soils.

The soils in this unit are suited to all of the crops commonly grown in the county. Corn, sorghum, and alfalfa are the main crops grown, and row crops can be grown year after year. These soils are also

suited to grass, trees, and other less intensive uses. Insects and plant diseases need to be controlled.

Capability Unit IIe-1, Dryland

This unit consists of deep, well-drained, very gently sloping to gently sloping soils on terraces and uplands. These soils are in the Hall, Hord, Loretto, and Moody series. The Loretto and Moody soils are moderately eroded. These soils have a surface layer of loam, silt loam, or silty clay loam and a subsoil of silt loam or silty clay loam. They are easy to work. Available water capacity is high, and permeability is moderate to moderately slow.

The main concerns of management are controlling water erosion and maintaining fertility. Terracing, cultivating on the contour, keeping tillage to a minimum, and returning all crop residues to the soils are ways of controlling erosion and maintaining tilth. Grassed waterways also are needed.

The soils in this unit are suited to all crops commonly grown in the county, but corn, sorghum, and alfalfa are the main crops grown. These soils are also suited to grass, trees, and other less intensive uses. Insects and plant diseases need to be controlled.

Capability Unit IIe-3, Dryland

This unit consists of deep, well-drained, very gently sloping to gently sloping soils. These soils are in the Hord, Loretto, and Ortello series. The Loretto soils are moderately eroded. These soils are subject to water erosion and soil blowing. They have a surface layer of fine sandy loam and a subsoil of silt loam or fine sandy loam. Available water capacity is moderate to high, and permeability is moderate to moderately rapid. These soils warm up earlier in spring than soils that have a finer textured surface layer.

The main concerns of management are controlling water erosion and soil blowing and maintaining fertility. Growing a cover crop of rye, wind stripcropping, returning all crop residues to the soils, and using shelterbelts help to control soil blowing and to maintain fertility. Terracing and farming on the contour are ways of controlling water erosion on the gentle slopes.

The soils in this unit are suited to most crops commonly grown in the county, but corn, sorghum, and alfalfa are the main crops grown. These soils are also suited to grass, trees, and other less intensive uses. Insects and plant diseases need to be controlled.

Capability Unit IIw-3, Dryland

Hobbs silt loam, 0 to 1 percent slopes occasionally flooded, is the only soil in this unit. This deep, nearly level soil is on bottom lands. It has a silt loam substratum. Available water capacity is high, and permeability is moderate. This soil is easy to till. Erosion is not a problem, but in some years silt laid down by flooding may damage crops.

On this soil the principal concern of management is occasional flooding. The flood water remains on the soil for only a short time, however, and damage to crops is seldom severe. Diversion terraces on higher areas help to protect this soil from flooding, and waterways help to carry away the runoff from the diversion terraces. Tilth and fertility can be maintained by returning crop residues to the soils, adding barnyard manure, and applying fertilizer.

Corn and sorghum are the main crops grown on this soil. Small grain and alfalfa can be grown, but they are likely to be damaged by excess water. This soil is also suited to grass, trees, and other less intensive uses. Insects and plant diseases need to be controlled.

Capability Unit IIw-4, Dryland

This unit consists of deep, somewhat poorly drained, nearly level soils on bottom lands. These soils are in the Lamo, Leshara, and Wann series. They have a surface layer of silty clay loam, silt loam, and loam. Their subsoil is silty clay loam, silt loam, and fine sandy loam. Available water capacity is high in the Lamo and Leshara soils and moderate in the Wann soils. Permeability is moderately slow to moderately rapid in these soils.

The principal concern of management is wetness caused by a water table at a depth between 2 and 6 feet. When the water table is high, the soils are difficult to cultivate. In dry years, however, a high water table is beneficial to crops. The water table is highest in spring and lowest in summer. If adequate outlets are available, open drains or tile drains can be used to provide drainage. Returning all crop residues to the soils and applying fertilizer help to maintain tilth and fertility.

Corn and sorghum are the main crops grown on these soils. Spring grain is seldom grown because of wetness early in spring. Alfalfa can be grown, but it is likely to be damaged by excess water. These soils are also suited to grass, trees, and other less intensive uses. Insects and plant diseases need to be controlled.

Capability Unit IIIe-1, Dryland

This unit consists of deep, well-drained, moderately sloping soils on uplands. These soils are in the Nora series. They are silt loam throughout. The erosion hazard is slight to moderate. Available water capacity is high, and permeability is moderate. These soils are easy to till.

The principal concerns of management are water erosion and runoff. Terraces, grassed waterways,

farming on the contour, and returning crop residues to the soil help to control erosion and runoff and to maintain fertility (pl. I). Keeping tillage to a minimum also helps to control erosion and runoff.

The soils in this unit are suited to all crops commonly grown in the county, but corn, sorghum, and alfalfa are the main crops grown. These soils are also suited to grass, trees, and other less intensive uses. Erosion can be controlled by limiting the number of years row crops are grown on these soils. Insects and plant diseases need to be controlled.

Capability Unit IIIe-3, Dryland

This unit consists of deep, well-drained to somewhat excessively drained, nearly level to moderately sloping soils on uplands and bottom lands. These soils are in the Inavale, Loretto, and Nora series. They have a surface layer of fine sandy loam to loamy fine sand and a subsoil of fine sand or silt loam. The erosion hazard is slight to moderate. Available water capacity is low to moderate, and permeability is rapid to moderate.

The main concerns of management are water erosion and soil blowing. Terracing, cultivating on the contour, stripcropping, field shelterbelts, grassed waterways, and minimum tillage are needed to control water erosion and soil blowing. These practices also help to maintain fertility.

The soils in this unit are suited to corn, sorghum, alfalfa, vetch, small grain, and native grass. They are also suited to trees and to such less intensive uses as scattered trees and grass.

Capability Unit IIIe-5, Dryland

This unit consists of deep, somewhat excessively drained, nearly level to gently sloping soils on terraces and uplands. These soils are in the Thurman series. They have a surface layer and subsoil of loamy fine sand and a substratum of loamy fine sand, fine sand, or silt loam. Available water capacity is low, and permeability is rapid.

The principal concern of management is soil blowing. These soils are subject to severe soil blowing if a vegetative cover is not maintained. Field windbreaks, wind stripcropping, returning crop residues to the soils, and minimum tillage are needed to control soil blowing. These practices also help to maintain tilth and fertility.

The soils of this unit are suited to most crops and grasses grown in the county. Corn, sorghum, rye, and vetch are the main crops grown, but many areas are in native grass. This soil is also suited to trees and other less intensive uses. Insects and plant diseases need to be controlled.

Capability Unit IIIe-8, Dryland

This unit consists of deep, well-drained, gently sloping to moderately sloping, eroded soils on uplands. These soils are in the Crofton, Moody, and Nora series. They have a surface layer and subsoil of silt loam to silty clay loam. Available water capacity is high, and permeability is moderately slow to moderate. Fertility is low to high, and content of organic matter is low. These soils are susceptible to sheet and gully erosion. They are easy to till.

The principal concerns of management are controlling erosion and maintaining fertility. Erosion can be controlled and fertility improved by terracing, cultivating on the contour, keeping tillage to a minimum, and by returning crop residues to the soils. Waterways also are needed.

The soils in this unit are suited to most crops commonly grown in the county, but corn, sorghum, and alfalfa are the main crops grown. These soils are also suited to grass, trees, and other less intensive uses. Insects and plant diseases need to be controlled.

Capability Unit IIIw-2, Dryland

Fillmore silt loam is the only soil in this unit. It is a deep, poorly drained, nearly level soil on uplands and in depressions on terraces. It has a surface layer of silt loam, a subsoil of silty clay to clay, and a substratum of silty clay loam. Available water capacity is high, and permeability is slow. Runoff is slow to ponded.

Field drains, arrangement of row direction, and open drainage ditches can be used to improve surface drainage. In many places diversion terraces can be used to control runoff from adjacent areas.

This soil is suited to many crops commonly grown in the county, but corn and sorghum are the main crops grown. It also is suited to trees and grass, to wildlife habitat, and to recreational uses. Alfalfa and small grain are not well suited because of wetness. Water generally stands on this soil for at least part of the year. Areas of this soil generally are used the same as surrounding soils.

Capability Unit IIIw-5, Dryland

Elsmere loamy fine sand is the only soil in this unit. It is a deep, somewhat poorly drained, very gently sloping soil that formed in material laid down by wind on terraces. The surface layer is loamy fine sand and the subsoil and substratum are fine sand. The water table fluctuates between a depth of 2 and 6 feet. Available water capacity is low, and permeability is rapid.

The principal concerns of management are soil blowing, and wetness caused by the high water table. Stripcropping, field shelter belts, minimum tillage, and returning crop residues to the soil help to control soil blowing and to maintain fertility.

This soil is used for crops, range, and native hay. It is suited to most of the crops commonly grown in the county, but corn, sorghum, and vetch are the main crops grown. Alfalfa and small grains

are not well suited because of wetness. Insects and plant diseases need to be controlled. In areas used for range and native hay, proper stocking, deferred grazing, and rotation grazing are needed to maintain the desired kinds of grass. This soil is also suited to trees, to wildlife habitat, and to recreational use.

Capability Unit IIIw-6, Dryland

Only Inavale soils, wet, is in this unit. It is a deep, moderately wet, nearly level soil on bottom lands. The surface layer is loam to loamy fine sand, and the subsoil and substratum are loamy fine sand to fine sand. The water table fluctuates between a depth of 2 and 6 feet. Available water capacity is low, and permeability is rapid.

The principal concerns of management are wetness and soil blowing. These soils tend to be droughty when the water table is low. Such practices as stripcropping and returning crop residues to the soils help to control soil blowing and to maintain fertility.

This soil is used for crops, grass, and trees. It is suited to most crops commonly grown in the county. Corn, sorghum, and alfalfa are the main crops grown, though alfalfa drowns out occasionally. Wetness early in spring often delays planting, and spring small grains therefore are not well suited. In areas used for range, proper stocking, deferred grazing, and rotation grazing are needed to maintain the desired kinds of grass. Some areas are used for native hay. This soil is also suitable for wildlife habitat and for recreational use.

Capability Unit IIIs-1, Dryland

Only Hall-Slickspots complex, 1 to 3 percent slopes, is in this unit. It consists of deep, well-drained, very gently sloping soils on terraces. Hall soils make up 70 percent of this complex, and Slickspots make up the remaining 30 percent. Slickspots are affected by salinity and alkalinity, and these salts break down the soil structure. The soils in this complex have a surface layer of silt loam to silty clay loam, a subsoil of silty clay loam to silty clay, and a substratum of silt loam. Available water capacity is high, and permeability is moderately slow to slow. The Slickspots are hard to work.

The principal concern of management is the alkalinity of the Slickspots. In areas not affected by alkalinity, maintaining fertility is the chief concern. Land leveling and additions of chemicals are needed to neutralize the spots of alkali.

Most of the acreage of this complex is used for crops, and corn, sorghum, and alfalfa are the main crops. This complex is also suited to such crops as wheat and grasses that tolerate salts. They are also suited to trees and other less intensive uses.

Capability Unit IVe-1, Dryland

Only Nora-Crofton silt loams, 12 to 17 percent slopes, is in this unit. It consists of deep, well-drained, strongly sloping soils on uplands. These soils are silt loam throughout. Available water capacity is high, and permeability is moderate. Runoff is medium. These soils are easy to till and are subject to erosion.

The principal concerns of management are controlling water erosion, maintaining fertility, and managing range properly. Terracing, cultivating on the contour, using grassed waterways, and keeping tillage to a minimum help to control erosion and to maintain fertility. Proper stocking, deferred grazing, rotation grazing, and controlling weeds and brush help to maintain the desired kinds of grass.

This complex is used for range and for hay. Under good management mid and tall grasses grow on these soils. This complex is also suited to trees and other less intensive uses.

Capability Unit IVe-8, Dryland

This unit consists of deep, well-drained, moderately sloping to strongly sloping soils on uplands. These soils are in the Crofton and Nora series. They are silt loam throughout and are moderately eroded to severely eroded. Available water capacity is high, permeability is moderate, and fertility is low. Runoff is moderate to rapid.

The principal concerns of management are controlling erosion and maintaining fertility. Cultivated crops can be grown on these soils, but the low fertility and severe hazard of further erosion make the soils better suited to grass or mixtures of grass and legumes than to other crops. Terracing, cultivating on the contour, and returning crop residues to the soils help to control erosion, conserve water, and maintain fertility. Waterways are also needed. Most areas of these soils are used for such crops as corn, sorghum, alfalfa, and bromegrass. Some areas have been seeded to native grass. These soils are also suited to grass, trees, and other less intensive uses.

Capability Unit Vw-1, Dryland

This unit consists of deep, poorly drained, nearly level soils on bottom lands and in depressions on terraces. These soils are in the Gannett and Loup series. The land type Wet alluvial land is also in this unit. The water table is at the surface or at a depth of less than 2 feet. The surface layer is silt loam to fine sandy loam, and the subsoil and substratum are silty clay loam to fine sand. Available water capacity is low to high, and permeability is moderate to rapid.

Because of the high water table, these soils are not suited to cultivation. They are used mostly for range and native hay and require no special

management. Willows, grasses, sedges, and other plants that tolerate wetness are the main vegetation. In some years wetness limits grazing. The areas are excellent for wildlife habitat and for recreational use.

Capability Unit VIe-5, Dryland

This unit consists of deep, somewhat excessively drained to excessively drained, nearly level to strongly sloping soils on sandy uplands and terraces. These soils are in the Thurman and Valentine series. They are loamy fine sand to fine sand throughout. Available water capacity is low, and permeability is rapid. If these soils are cultivated or overgrazed, the hazard of soil blowing is severe.

Steep slopes and the hazard of soil blowing make these soils unsuitable for cultivation. The small areas now cultivated should be seeded to native grass. Most areas of these soils are used for range or for native hay. These soils are also suited to trees and other less intensive uses. Proper stocking, deferred grazing, rotation grazing, and control of weeds and brush are ways of controlling erosion and maintaining the desired kinds of grass in the range.

Capability Unit VIe-8, Dryland

Crofton silt loam, 17 to 30 percent slopes, eroded, is the only soil in this unit. It is a deep, excessively drained, steep, eroded soil on uplands. The surface layer and substratum are silt loam. Runoff is rapid, available water capacity is high, and permeability is moderate. Fertility and content of organic matter are low.

Steep slopes and the hazard of further erosion make this soil poorly suited to cultivation. This soil is well suited to grass and trees. It also is well suited to use as wildlife habitat and recreational areas. Most of the acreage is cultivated because it is in the same fields as less sloping soils. Converting to native grasses helps to control erosion. Areas seeded need proper management to insure a good cover of grass. Proper stocking, deferred grazing, and control of weeds and brush help to establish a good stand of grass.

In places good sites for dams are along drainageways.

Capability Unit VIe-9, Dryland

Only Crofton-Nora silt loams, 17 to 30 percent slopes, is in this unit. This complex consists of deep, steep soils on uplands. It has a silt loam surface layer and subsoil. Runoff is rapid, available water capacity is high, and permeability is moderate. The hazard of erosion is slight.

The soils in this unit are subject to severe erosion if overgrazed or if the vegetation is removed. The principal concern of management is maintaining a good cover of grass on the areas. The soils are not suited to cultivation. They are suited to grass, to trees, to use as wildlife habitat and as recreational areas. Good sites for dams occur along drainageways. These dams can be used to provide water for livestock or for recreational purposes. Proper stocking, deferred grazing, and rotation grazing are needed to maintain the proper kinds of grass.

Capability Unit VIw-1, Dryland

This unit consists of deep, nearly level, mixed silty and sandy soils on bottom lands. Sandy alluvial land and Silty alluvial land make up this unit. These land types are subject to frequent flooding. They occur in long narrow areas along intermittent streams that flood several times a year.

Frequent flooding is the principal concern of management. Most of the land area is in native grass and trees or is bare of vegetation. Cultivated crops are not suited. These land types are suitable for grass and trees and for use as wildlife habitat and recreational areas. Proper stocking, deferred grazing, and control of weeds and brush help to maintain the desired kinds of grass. In places structures are needed to control gullies.

Capability Unit VIw-5, Dryland

Elsmere fine sand is the only soil in this unit. It is a deep, somewhat poorly drained, nearly level to gently sloping soil on terraces. The surface layer and subsoil are fine sand. Available water capacity is low, and permeability is rapid. The water table is at a depth of 2 to 6 feet.

This soil is not suited to cultivation. It is too sandy and it is subject to severe soil blowing if the cover of vegetation is removed. Also, in spring and early in summer the soil is too wet for normal seedbed preparation and planting activities. This soil is used for native range and for hay. Proper stocking, deferred grazing, and other good range management practices are needed to maintain the desired kinds of grass.

Capability Unit VIIe-1, Dryland

Only Loess hills and bluffs is in this unit. It consists of excessively drained, very steep soils that are catstepped (pl. II). The texture is dominantly silt loam, but sand occurs in scattered areas on the lower slopes. The hazard of erosion is severe. Runoff is rapid, and permeability is moderate.

This mapping unit is suited to grass and trees. It is also suitable for use as wildlife habitat and for recreational areas. The areas are used for range and have a cover of tall and short grasses.

Good grazing management is needed to control erosion and to maintain the proper kinds of grass. Leaving 50 percent or more of the growth each year at the end of the growing season keeps a cover of grass on the areas and helps to control erosion.

Capability Unit VIIe-5, Dryland

Only Blown-out land is in this capability unit. It consists of deep, excessively drained, gently sloping to strongly sloping fine sand. The mapped areas consist of several small blow outs or of one large blow out. Available water capacity and content of organic matter are low, and permeability is rapid. The areas are severely eroded and have little vegetation on them.

Control of erosion is needed on this land before any stabilization can take place. A suitable practice is to grow a cover crop and then seed a mixture of native grasses. Where severe soil blowing has caused steep slopes, leveling is needed before seeding is done. This land type is suited to grass and trees. It also is suitable for use as wildlife habitat and recreational areas.

Capability Unit VIIIw-3, Dryland

Only Marsh is in this capability unit. It is subject to frequent flooding and has water on or near the surface most of the time. Marsh is well suited to use as habitat for wildlife and as recreational areas. The sites are suitable for ducks, geese, fish, and other game. Cattails, rushes, sedges, and other plants that tolerate wetness make up much of the vegetation.

Irrigated Capability Units

The irrigated soils of Boone County are scattered throughout the valleys of most of the streams in the county. Where water is available, small areas of level soils on tableland are also irrigated. Water for irrigation is obtained mostly from wells.

Different methods of irrigation are needed when the kind of crop grown on a particular field is changed. The method used in irrigating a row crop is different than that used to irrigate a close-sown crop. Changing the irrigation method is difficult if slopes are more than 2 percent, and some farmers consider bench leveling irrigated fields so that all slopes are less than 1 percent. In this way changing the method of irrigation is easier.

Furrow irrigation is the most common method for irrigating row crops. The water is applied to furrows between the plant rows by gated pipe or by siphon tubes. Furrows on nearly level soils, such as those of the Hall, Hobbs, and Hord silt loams, generally are straight. On steeper soils, such as the Hord and Hall silt loams on 1 to 3 percent slopes, contour furrows generally are used to carry irrigation water across the slope rather than down the slope. In places, for example, on Moody silty clay loam, 3 to 7 percent slopes, contour furrows need to be supplemented by terraces.

In the corrugation irrigation method, water is applied in small furrows by gated pipe or siphon tubes. From the small furrows the water moves laterally through the soil and wets the entire field. This method is suited to close-growing crops, chiefly alfalfa.

In the border irrigation method, flooding is controlled by borders or small dikes along the sides of narrow cultivated areas. The irrigation water flows in a thin, uniform sheet and is absorbed by the soil as it advances. For this method to work well, the strip needs to be well leveled and of uniform grade. The dikes between the strips should be low and rounded so that they can be planted along with the strips. Border irrigation is better suited to the Hall, Hobbs, and Hord silt loams on 0 to 1 percent slopes than to other soils in the county.

In the controlled flooding method, the applied water flows down the slope between field ditches that are closely spaced. Frequent openings in the ditches permit uniform distribution of the water over the field. This method is suitable only for close-growing crops or hay crops. It is well suited to the steeper soils, such as Moody silty clay loam, 3 to 7 percent slopes, and Nora silt loam, 7 to 12 percent slopes.

In the sprinkler irrigation method, water is applied by sprinklers at a rate that the soil can absorb it without runoff. Sprinklers can be used on the steeper soils, as well as on the more level ones. Some soils, such as the Nora silt loam, 7 to 12 percent slopes, and the Nora-Moody complex, 3 to 7 percent slopes, eroded, are well suited to the sprinkler method. Because the water can be carefully controlled, sprinklers have special uses in conservation, such as establishing pastures on steep slopes. In summer, however, much water is lost through evaporation. Also, wind drift causes uneven application of water.

Soil holds a limited amount of water. Irrigation water, therefore, should be applied at regular intervals to keep the soil profile wet at all times. The interval varies according to the crop. The water can be applied only as fast as the soil can absorb it.

On the average irrigated soils in Boone County hold, available for plants, about 2 inches of water per foot of soil depth. A soil that is 6 feet deep and is planted to a crop that sends its roots to that depth holds about 12 inches of water available for that crop.

Best efficiency is attained if the irrigation process is started when about half of the stored water has been used by the plants. Thus, if a soil holds 12 inches of available water, irrigation should be started when about 6 inches has been removed by the crop. Irrigation sets should be planned to replace the amount that is used by the crop.

Management is needed that controls or regulates the application of irrigation water in such a way that good crop growth is obtained without wasting water or soil. Adjusting the size of the stream into the furrow or the sprinkler irrigation rate thoroughly moistens the soil and helps to conserve water. Water can be applied most efficiently by using a fairly good-sized stream down the row until water nearly reaches the lower end and then reducing the stream size to about one-half the original rate and allowing it to flow until the soil is irrigated.

Assistance in planning and laying out an irrigation system is available through the local office of the Soil Conservation Service and the county agricultural agent. Estimates of cost information about equipment can be obtained from manufacturers of irrigation equipment.

Irrigated soils produce larger yields than dryfarmed soils. Consequently, more plant nutrients are removed in the harvested crops, especially nitrogen and phosphorus. Returning all crop residues to the soil and adding barnyard manure and commercial fertilizers help to supply needed plant nutrients. Most grain crops respond to nitrogen fertilizer. Soils disturbed during land leveling, especially if the topsoil has been removed, respond if phosphorus, zinc, and iron are added. The kinds and amounts of fertilizer needed for specific crops can be determined by soil tests.

The main crops irrigated in Boone County are corn, grain sorghum, and alfalfa. Corn and grain sorghum are grown in rows spaced 20 to 40 inches apart. Irrigation water is applied by furrows between the rows. Alfalfa is irrigated by flooding or by the sprinkler system.

The cropping sequence on soils well suited to irrigation, such as Hall silt loam, Hobbs silt loam, and Hord silt loam, consists mostly of row crops. Changes of corn with grain sorghum and a nonirrigated wheat crop help to control the cycle of diseases and insects that are sometimes present if the same crop is grown year after year. Sloping soils that are irrigated, such as Moody silty clay loam, 3 to 7 percent slopes, eroded, and Nora silt loam, 7 to 12 percent slopes, are subject to water erosion. Such soils are better suited to a cropping sequence that includes 2 to 5 years of row crops followed by 3 to 5 years of hay, mostly alfalfa or a mixture of alfalfa and grass.

Soils under irrigation generally need management that differs from that needed by the same soil if it is dryfarmed. In the paragraphs that follow the capability units, or groups of soils similar in management requirement for irrigation are described; some limitations are given; and suitable management is discussed. The names of the soil series represented are mentioned in the description of each capability unit, but this does not mean that all soils of a given series appear in the unit. The names of all the soils in any given capability unit can be found in the "Guide to Mapping Units" at the back of this survey.

Capability Unit I-1, Irrigated

This unit consists of deep, nearly level, well-drained soils on uplands, terraces, and bottom lands. These soils are in the Belfore, Cass, Hall, Hobbs, and Hord series. They have a surface layer of loam to silt loam and a subsoil of fine sandy loam, silt loam, and silty clay loam. Available water capacity is high in these soils, except for the Cass soils which have low to moderate available water capacity. Permeability is moderately rapid in the Cass soils and moderate and moderately slow in the others. The soils in this unit are easy to till. Runoff is slow. At times runoff from adjacent uplands is a problem on the Hobbs soils. The soils in this unit have few restrictions under irrigation.

These soils are suited to all crops commonly grown in the county, but corn, sorghum, and alfalfa are the main crops grown. Fertility can be maintained by returning all crop residues to the soils and applying fertilizer. A change in the kind of crop grown helps to reduce the hazard of insects and diseases. Little land grading is needed on these soils, and any method of irrigation can be used.

Capability Unit IIe-1, Irrigated

This unit consists of deep, well-drained, very gently sloping soils on terraces and uplands. These soils are in the Hall, Hord, and Moody series. They are silt loam or silty clay loam throughout. Available water capacity is high, and permeability is moderate to moderately slow. These soils are easy to till. The hazard of erosion is slight to moderate.

Management is needed that controls losses of water and soil. Land leveling that provides for even distribution of water, that allows for uniform drainage, and that reduces the hazard of erosion is needed if these soils are gravity irrigated. Sprinkler irrigation is suited.

These soils are suited to all crops commonly grown in the county, but corn, sorghum, and alfalfa are the main crops grown. Fertility can be maintained by returning crop residues to the soils and by applying fertilizer. Insects and plant diseases need to be controlled.

Capability Unit IIe-3, Irrigated

This unit consists of deep, well-drained, very gently sloping soils on uplands and terraces. These soils are in the Hord, Loretto, and Ortello series. They have a surface layer of sandy loam, a subsoil of fine sandy loam to silt loam, and a substratum of silt loam. Available water capacity is moderate to high, and permeability is moderate to moderately rapid. These soils are easy to till. They are subject to water erosion and soil blowing.

The principal concerns of management are water erosion and maintaining fertility. If these soils are gravity irrigated, land leveling is needed to provide an even distribution of water, to allow uniform drainage, and to reduce the hazard of erosion. Sprinkler irrigation is suited. Returning crop residues to the soils, keeping tillage to a minimum, planting windbreaks, and applying fertilizer are ways of controlling soil blowing and maintaining fertility.

The soils in this unit are suited to most crops commonly grown in the county, but corn, sorghum, and alfalfa are the main crops grown. Insects and plant diseases need to be controlled.

Capability Unit IIw-4, Irrigated

This unit consists of deep, somewhat poorly drained, nearly level soils on bottom lands. These soils are in the Lamo, Leshara, and Wann series. They have a surface layer of loam, silt loam, and silty clay loam. Their subsoil is silty clay loam, silt loam, and fine sandy loam, and their substratum ranges from fine sand to silty clay. Available water capacity is high in the Lamo and Leshara soils and moderate in the Wann soils. Permeability is moderately slow to moderately rapid. These soils are easy to till. The water table is at a depth of 2 to 6 feet.

The principal concern of management is wetness caused by the high water table. If outlets are available, open drains or tile drains can be used to provide drainage. Land leveling helps to improve gravity irrigation and surface drainage. It also helps to provide for efficient application of water. Returning all crop residues to the soils and applying fertilizer help to maintain fertility. In most years wetness in spring delays the preparing of a seedbed.

These soils are suited to corn, sorghum, and alfalfa. Grass and other crops are also suited. Any method of irrigation can be used. Insects and plant diseases need to be controlled.

Capability Unit IIs-1, Irrigated

Only Hall-Slickspots, complex, 1 to 3 percent slopes, is is in this capability unit. It is a deep, very gently sloping soil on terraces. More than 30 percent of the Slickspots acreage is affected by salts or alkali. The Slickspots have poor drainage, the Hall soils are well drained. These soils have a surface layer of silt loam, a subsoil of silty clay loam to silty clay, and a substratum of silt loam. Available water capacity is high, and permeability is slow to moderately slow. The Slickspots are difficult to till, and Hall soils are easy to till.

The principal concerns of management are slow plant growth, slow intake of water, and accumulation of salts or alkali in the Slickspots. Land leveling the Slickspots helps to improve surface drainage and conserve water. Adding sulfur and gypsum helps to neutralize the areas of salts or alkali. Returning crop residues to the soils and adding fertilizer helps to maintain fertility. Areas not affected by alkali have few concerns other than good water management and maintaining fertility. Both gravity and sprinkler irrigation are suited.

Corn, sorghum, and alfalfa are the main crops. Grasses and other crops that tolerate salt are also suited. Insects and plant diseases need to be controlled.

Capability Unit IIs-2, Irrigated

Fillmore silt loam is the only soil in this capability unit. It is a deep, poorly drained, nearly level soil in depressions on terraces and uplands. This soil has a silt loam surface layer, a clay subsoil, and a silty clay loam substratum. Available water capacity is high, and permeability is slow. Runoff ponds on the surface of this soil.

The principal concerns of management are the poor surface drainage and a claypan that restricts air and water. Returning all crop residues to the soils and applying fertilizer help maintain fertility. This soil is suited to sprinkler irrigation, but improvement of surface drainage is needed to keep the crops from drowning. Land leveling is needed for gravity irrigation.

This soil is suited to most crops commonly grown in the county. Corn, sorghum, and alfalfa are the main crops grown. If alfalfa is grown, movement of water through the soil is increased because the roots produce openings in the claypan. Insects and plant diseases need to be controlled.

Capability Unit IIIe-1, Irrigated

This unit consists of deep, well-drained, gently sloping soils on terraces and uplands. The soils in this unit are in the Hord, Loretto, Moody, and Nora series. These soils have a surface layer of loam, silt loam, and silty clay loam, a subsoil of silt loam or silty clay loam, and a substratum of silt loam. Available water capacity is high, and permeability is moderate to moderately slow. These soils are easy to till. Erosion is slight to moderate.

The principal concerns of management are controlling water erosion and maintaining fertility. If these soils are gravity irrigated, bench leveling is needed to control erosion. Contour furrows are the best method of irrigation for row crops. Terraces help supplement contour rows. If erosion is controlled, these soils are suited to sprinkler irrigation. Returning crop residues to the soils, keeping tillage to a minimum, and applying fertilizer help to control erosion and to maintain fertility.

Corn, sorghum, and alfalfa are the main crops. Grasses and other crops are also suited. Insects and plant diseases need to be controlled.

Capability Unit IIIe-3, Irrigated

Only Loretto fine sandy loam, 3 to 7 percent slopes, eroded, is in this unit. It is a deep, well-drained, gently sloping soil on uplands. The surface layer is fine sandy loam, the subsoil is loam to silt loam, and the substratum is silt loam. Available water capacity and permeability are moderate. This soil is easy to till. The hazard of erosion is moderate.

The principal concerns of management are controlling water erosion and soil blowing and maintaining fertility. If this soil is gravity irrigated, land leveling is needed to help provide an even distribution of water and to control erosion. In places bench leveling and contour furrows are preferred for row crops. If erosion is controlled, this soil is suited to sprinkler irrigation. Stripcropping, returning crop residues to the soils, and applying fertilizer help to control erosion and to maintain fertility.

Corn, sorghum, and alfalfa are the main crops. Grasses and other crops are also suited. Insects and plant diseases need to be controlled.

Capability Unit IVe-1, Irrigated

This unit consists of deep, well-drained, moderately sloping soils on uplands. These soils are in the Crofton and Nora series, and some of them are eroded. They are silt loam throughout. Available water capacity is high, and permeability is moderate. Erosion is moderate. These soils are easy to till. Runoff is moderately rapid.

The principal concerns of management are controlling erosion, managing water for control of erosion, and maintaining fertility. The steep slopes and hazard of further erosion make these soils better suited to hay and pasture than to cultivated crops. Row crops can be grown on these soils, however, for 1 or 2 years in succession. Corn, sorghum, alfalfa, and grass are the main crops grown.

Sprinkler irrigation works well on these soils. Other methods of irrigation are difficult to manage, and the cost of land preparation is high. Terraces are needed to control water erosion, and waterways can be used to carry away excess water. Returning all crop residues to the soils and applying fertilizer help to maintain fertility. Insects and plant diseases need to be controlled.

Capability Unit IVe-5, Irrigated

This unit consists of deep, somewhat excessively drained, nearly level to very gently sloping soils on uplands and terraces. The soils in this unit are in the Thurman series. They have a surface layer and a subsoil of loamy fine sand and a substratum of fine sand to silt loam. Available water capacity is low, permeability is rapid, and fertility is medium. These soils are subject to blowing.

The principal concerns of management are soil blowing, and maintaining fertility. Sprinkler irrigation is better suited than other methods for irrigating these soils. Frequent applications of water are needed. If these soils are gravity irrigated, land leveling, short runs, and frequent irrigations are needed. Thurman loamy fine sand, silty substratum, 0 to 3 percent slopes, retains more water in the profile than the soils that have a fine sand substratum. Returning crop residues to the soils, stripcropping, using field windbreaks, keeping tillage to a minimum, and applying fertilizer help to control soil blowing and to maintain fertility.

Alfalfa, sorghum, and corn are the main crops. Grass is also well suited. Insects and plant diseases need to be controlled.

Predicted Yields

The predicted average acre yields for principal irrigated and dryfarmed crops grown on the soils of Boone County are given in table 2. Only the major crops that are irrigated are listed under irrigation. Irrigation generally has not been developed on some suited soils, and yields therefore are not shown for those soils.

The predictions in table 2 are based on information obtained from farmers, ranchers, the Extension Service, the Nebraska Annual Statistics Report, and on observations made by others who are familiar with the soils of the county. The yields are averages for a long period of time. In years when rainfall is above average, the yields of dryfarmed crops are higher than those listed. Also yields can be expected to improve as new techniques and varieties become available. When the crops are damaged by hail, disease, insects, or other causes, the yields are lower than those listed.

The predicted yields in table 2 are listed under two levels of management. Those in columns A can be expected under current management, the management used by most farmers in the county. Under this management the farmer fails to use all the practices needed for a higher level of management.

Yields in columns B are those that can be expected when the farmer uses the improved management listed in the paragraphs that follow.

1. Uses practices that control soil blowing and water erosion. Uses terraces, grassed waterways, stripcropping, field windbreaks where needed.
2. Uses a suitable cropping sequence that maintains tilth and content of organic matter.
3. Applies fertilizer of the kind and in the amount needed.
4. Plants adapted crop varieties at the proper rate.
5. Uses insect, weed, and disease controls consistently.
6. Drains the soil where needed.
7. Prepares soil for irrigation.
8. Carefully applies water to irrigated land.
9. Performs all practices of management at the time needed.

TABLE 2.--PREDICTED AVERAGE ACRE YIELDS OF PRINCIPAL IRRIGATED AND DRYFARMED CROPS

[In columns A are yields under prevailing management; in columns B are yields under improved management. Absence of figure indicates the crop is not suited to the soil, is not commonly grown, or that irrigation is not practical]

Mapping unit	Corn				Sorghum				Oats		Alfalfa			
	Dryland		Irrigated		Dryland		Irrigated		Dryland		Dryland		Irrigated	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Tons	Tons	Tons	Tons
Belfore silt loam, 0 to 1 percent slopes	47	66	105	135	50	70	100	130	30	50	3.0	4.0	4.5	6.0
Blown-out land	--	--	---	---	--	--	---	---	--	--	---	---	---	---
Cass soils	44	60	90	120	45	60	90	120	--	--	3.0	4.0	---	---
Crofton silt loam, 7 to 17 percent slopes, eroded	23	33	---	---	25	35	---	---	--	--	1.7	2.3	---	---
Crofton silt loam, 17 to 30 percent slopes, eroded	--	--	---	---	--	--	---	---	--	--	---	---	---	---
Crofton-Nora silt loams, 7 to 12 percent slopes, eroded	35	55	75	100	30	50	75	100	20	40	2.3	3.0	3.5	4.5
Crofton-Nora silt loams, 12 to 17 percent slopes, eroded	28	40	---	---	30	40	---	---	17	35	2.0	2.5	---	---
Crofton-Nora silt loams, 17 to 30 percent slopes	--	--	---	---	--	--	---	---	--	--	---	---	---	---
Elsmere fine sand	--	--	---	---	--	--	---	---	--	--	---	---	---	---
Elsmere loamy fine sand	37	42	---	---	37	42	---	---	--	--	---	---	---	---
Fillmore silt loam	35	60	100	130	32	55	95	120	--	--	2.5	3.5	4.0	5.5
Gannett fine sandy loam	--	--	---	---	--	--	---	---	--	--	---	---	---	---
Hall silt loam, 0 to 1 percent slopes	50	70	115	150	50	70	110	145	30	50	3.5	4.0	4.5	6.0
Hall silt loam, 1 to 3 percent slopes	46	65	110	145	47	66	105	140	30	50	3.2	3.8	4.3	5.8
Hall-Slickspots complex, 1 to 3 percent slopes	32	54	85	120	35	55	80	115	--	--	2.5	3.5	4.0	5.0
Hobbs silt loam, 0 to 1 percent slopes,	52	70	110	150	55	70	105	145	35	50	3.5	4.2	4.7	6.0
Hobbs silt loam, 0 to 1 percent slopes, occasionally flooded	47	65	100	145	47	62	95	140	--	--	---	---	---	---
Hord silt loam, 0 to 1 percent slopes	50	70	115	150	50	70	110	145	30	50	3.0	3.6	4.5	6.0
Hord silt loam, 1 to 3 percent slopes	46	65	110	145	45	62	105	140	30	50	2.9	3.5	4.3	5.8
Hord silt loam, 3 to 7 percent slopes	44	63	90	120	43	62	90	120	27	45	3.0	3.5	4.3	5.8
Hord silt loam, terrace, 0 to 1 percent slopes	50	70	115	150	50	66	110	145	30	50	3.5	4.0	4.5	6.0
Hord silt loam, terrace, 1 to 3 percent slopes	46	65	110	145	46	62	105	140	30	50	3.2	3.8	4.3	5.8
Hord and Ortello fine sandy loams, 1 to 3 percent slopes	45	65	110	135	45	60	100	130	30	50	3.5	4.0	4.5	6.0
Inavale soils	25	35	---	---	25	35	---	---	--	--	1.7	2.3	---	---
Inavale soils, wet	33	38	---	---	33	38	---	---	--	--	2.2	3.0	---	---
Lamo silty clay loam	50	75	110	150	50	70	105	145	--	--	3.2	4.0	4.3	5.7
Leshara silt loam	50	75	110	150	50	70	105	145	--	--	3.0	3.8	4.1	5.5
Loess hills and bluffs	--	--	---	---	--	--	---	---	--	--	---	---	---	---

TABLE 2.--PREDICTED AVERAGE ACRE YIELDS OF PRINCIPAL IRRIGATED AND DRYFARMED CROPS--Continued

Mapping unit	Corn				Sorghum				Oats		Alfalfa			
	Dryland		Irrigated		Dryland		Irrigated		Dryland		Dryland		Irrigated	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Tons	Tons	Tons	Tons
Loretto fine sandy loam, 0 to 3 percent slopes, eroded	45	65	100	130	45	65	100	130	--	--	2.5	3.5	---	---
Loretto fine sandy loam, 3 to 7 percent slopes, eroded	42	60	95	120	42	60	95	115	--	--	2.2	3.2	---	---
Loretto loam, 3 to 7 percent slopes, eroded	42	60	95	120	43	60	95	115	--	--	2.7	3.5	---	---
Loretto-Nora fine sandy loams, 7 to 12 percent slopes, eroded	35	52	---	---	35	50	---	---	--	--	2.0	2.5	---	---
Loup loam	--	--	---	---	--	--	---	---	--	--	---	---	---	---
Marsh	--	--	---	---	--	--	---	---	--	--	---	---	---	---
Moody silty clay loam, 1 to 3 percent slopes	45	65	105	135	45	62	105	130	30	50	3.0	3.8	4.3	5.8
Moody silty clay loam, 1 to 3 percent slopes, eroded	45	60	100	135	145	60	100	130	30	50	2.8	3.8	4.3	5.8
Moody silty clay loam, 3 to 7 percent slopes, eroded	45	60	95	120	43	62	90	115	28	47	2.7	3.7	4.0	5.0
Nora silt loam, 7 to 12 percent slopes	40	60	85	115	40	60	80	105	25	45	2.5	3.5	4.0	5.0
Nora silt loam, 7 to 12 percent slopes, eroded	40	60	80	110	40	60	75	100	25	45	2.5	3.5	4.0	5.0
Nora-Crofton silt loams, 12 to 17 percent slopes	35	55	---	---	37	55	---	---	20	40	2.2	3.0	---	---
Nora-Moody complex, 3 to 7 percent slopes, eroded	35	55	90	115	35	55	90	115	--	--	2.5	3.5	4.0	5.0
Sandy alluvial land	--	--	---	---	--	--	---	---	--	--	---	---	---	---
Silty alluvial land	--	--	---	---	--	--	---	---	--	--	---	---	---	---
Thurman loamy fine sand, 0 to 3 percent slopes	40	55	---	---	40	55	---	---	20	30	2.0	3.0	3.5	4.0
Thurman loamy fine sand, 3 to 7 percent slopes	37	50	---	---	37	50	---	---	18	28	1.7	2.5	---	---
Thurman loamy fine sand, 7 to 12 percent slopes	--	--	---	---	--	--	---	---	--	--	---	---	---	---
Thurman loamy fine sand, silty substratum, 0 to 3 percent slopes	45	55	---	---	45	55	---	---	20	30	2.5	3.5	---	---
Thurman loamy fine sand, terrace, 0 to 3 percent slopes	40	55	---	---	40	55	---	---	20	30	2.5	3.5	4.0	5.0
Thurman-Valentine complex, 0 to 3 percent slopes	25	35	---	---	20	30	---	---	--	--	1.0	2.0	---	---
Valentine fine sand, rolling	--	--	---	---	--	--	---	---	--	--	---	---	---	---
Valentine loamy fine sand, undulating	--	--	---	---	--	--	---	---	--	--	---	---	---	---
Wann loam	45	65	105	140	48	65	105	135	--	--	2.7	3.7	4.0	5.5
Wet alluvial land	--	--	---	---	--	--	---	---	--	--	---	---	---	---

RANGE MANAGEMENT [3/]

Nearly 25 percent of the farmland in Boone County is range. Range is scattered throughout the county but is somewhat concentrated on the sandy soils in the western part. Most of it is not suitable for cultivation. Valentine and Nora-Crofton-Moody are the major soil associations in range. Raising livestock, mainly cows and calves, and selling calves as feeders is the second largest agricultural enterprise in the county.

Range Site and Condition Classes

The kinds of grass that grow on a certain site depend on the kinds of soil. The farmer needs to know of the kinds of soil in his holdings and the plants each kind is capable of growing. Then he can manage the range to favor the growth of the best forage plants on each kind of soil.

A range site is a distinctive kind of range that produces a kind and amount of climax vegetation significantly different from that on other sites. A significant difference is one that is large enough to require different grazing use of management to maintain or improve the vegetation. Climax vegetation is the combination of plants that originally grew on a given site. The most productive combination of forage plants on a site generally is the climax type of vegetation.

Vegetation is altered by intensive grazing. Livestock graze selectively. They constantly seek the more palatable and nutritious plants. Climax plants react to grazing by decreasing or increasing in number. The decreasers are the plants most heavily grazed; they therefore are the first to be injured by overgrazing. The increasers either withstand grazing better or are less palatable to the livestock; they increase under grazing and replace the decreasers. If heavy grazing continues, the increasers eventually decrease and are replaced by invaders. Invaders are plants not in the original plant community that begin growing when the decreasers and increasers have been weakened or eliminated.

Range condition is the present state of the vegetation in relation to the climax conditions for the site. Four range condition classes are defined. A range in excellent condition has present from 76 percent to 100 percent of the vegetation characteristics of the climax vegetation on the same site; one in good condition, 51 to 75 percent; one in fair condition, 26 to 50 percent; and one in poor condition, less than 25 percent.

Descriptions of Range Sites

In the pages that follow, brief descriptions of range sites are given, including topography, soil texture, and the dominant vegetation on the site when in excellent condition and when in poorer condition. Also given for each site is the annual yield of forage when the site is in excellent condition. These yields can be expected to vary according to the rainfall received each year. The "Guide to Mapping Units" shows which site each individual soil is in.

Wetland Range Site

In this site are nearly level, poorly drained soils on bottom lands and in upland depressions. These soils are in the Gannett and Loup series. The land type, Wet alluvial land, is also in this site. The surface layer of the soils in this site ranges from fine sandy loam to loam. The water table is at a depth of less than 3 feet for most of the year or water is ponded on the areas during part of the growing season.

At least 65 percent of the climax plant cover is such decreasers as prairie cordgrass and reedgrass. Sedges are the main increasers. Kentucky bluegrass, redtop, and willows, are the main invaders, though prairie cordgrass and sedges grow in places.

The total annual yield of air-dry forage on this range site normally is 7,000 pounds per acre, but it ranges from 6,500 pounds per acre in unfavorable years to 7,500 pounds per acre in favorable years.

Subirrigated Range Site

This site consists of nearly level, somewhat poorly drained soils on bottom lands. These soils are in the Elsmere, Inavale, Lamo, Leshara, and Wann series. They vary in texture and depth and are calcareous in places. The water table is at a depth of 20 to 60 inches, and it is within the root zone during the growing season. It has been the dominant influence on the vegetation.

At least 75 percent of the climax plant cover is a mixture of big bluestem, indiangrass, switchgrass, prairie cordgrass, Canada wildrye, and other decreasers. Little bluestem, western wheatgrass, and sedges are the main increasers. Kentucky bluegrass, foxtail barley, redtop, and blue verbena, are the main invaders, though western wheatgrass and sedges grow in places.

The total annual yield of air-dry forage on this range site normally is 5,800 pounds per acre, but it ranges from 5,500 pounds per acre in unfavorable years to 6,500 pounds per acre in favorable years.

Silty Overflow Range Site

This site is on bottom lands that are flooded periodically. It is made up of soils in the Hobbs series and of the miscellaneous land type Silty alluvial land. The surface layer and the subsoil

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3/ By PETER N. JENSEN range conservationist, Soil Conservation Service.

range from very fine sandy loam to silty loam. Flooding, deposition of silt, high water-holding capacity, and a moderate infiltration rate have been the dominant influence on the vegetation.

Decreasers make up from 70 to 75 percent of the climax plant cover. Big bluestem, indiangrass, switchgrass, and Canada wildrye are the main decreasers. Western wheatgrass, little bluestem, side-oats grama, and sedges are the main increasers. Kentucky bluegrass, Baldwin ironweed, western wheatgrass, and blue grama are the main invaders.

The total annual yield of air-dry forage on this range site normally is 5,000 pounds per acre, but it ranges from 4,500 pounds per acre in unfavorable years to 5,500 pounds per acre in favorable years.

Clayey Overflow Range Site

Only Fillmore silt loam is in this range site. It is a nearly level soil on terraces and uplands. The surface layer is silt loam, and the subsoil is silty clay to clay. Flooding, runoff from higher lying soils, slow surface runoff, and poor internal drainage have been the dominant influences on the vegetation.

Decreasers make up from 50 to 65 percent of the climax plant cover. Big bluestem, Canada wildrye, indiangrass, little bluestem, and switchgrass are the main decreasers. Blue grama, side-oats grama, western wheatgrass, and sedges are the main increasers. Western ragweed, Kentucky bluegrass, Baldwin ironweed, western wheatgrass, blue grama, and buffalograss are the main invaders.

The total annual yield of air-dry forage on this range site normally is 4,000 pounds per acre, but it ranges from 3,500 pounds per acre in unfavorable years to 5,000 pounds per acre in favorable years.

Sandy Lowland Range Site

This site is on bottom lands that are flooded periodically. It is made up of nearly level, well-drained soils in the Cass and Thurman series and of the land type, Sandy alluvial land. The surface layer ranges from sandy loam to loamy sand, and the subsoil ranges from sandy loam to fine sand. The water table is at a depth of 5 to 8 feet. Flooding and the water table have been the dominant influences on the vegetation.

Decreasers make up from 75 to 85 percent of the climax plant cover. Sand bluestem, little bluestem, indiangrass, switchgrass, needle-and-thread, and Canada wildrye, are the main decreasers. Prairie sandreed, sandreed, sand dropseed, western wheatgrass, and sedges are the main increasers. Sand dropseed, blue grama, and western ragweed are the main invaders.

The total annual yield of air-dry forage on this range site normally is 4,500 pounds per acre, but it ranges from 4,000 pounds per acre in unfavorable years to 5,000 pounds per acre in favorable years.

Silty Lowland Range Site

This site is on bottom lands and terraces that seldom are flooded. It is made up of soils in the Hall, Hobbs, and Hord series and of areas of Slick-spots. The surface layer and the subsoil range from silt loam to silty clay loam. Runoff from higher lying soils, high water-holding capacity, and a moderate to moderately slow infiltration rate have been the dominant influences on the vegetation.

Decreasers make up about 75 percent of the climax plant cover. Big bluestem, indiangrass, switchgrass, little bluestem, neddle-and-thread, and Canada wildrye are the main decreasers. Blue grama, side-oats grama, and western wheatgrass are the main increasers. Kentucky bluegrass, western wheatgrass, blue grama, western ragweed, and Baldwin ironweed are the main invaders.

The total annual yield of air-dry forage on this range site normally is 4,800 pounds per acre, but it ranges from 4,000 pounds per acre in unfavorable years to 5,500 pounds per acre in favorable years.

Sands Range Site

This site is made up of gently sloping to steep soils in the Inavale, Thurman, and Valentine series and of the land type, Blown-out land. The surface layer and the subsoil range from loamy sand to sand. Moisture is stored deep in these soils but is readily available to plants. This has been the dominant influence on vegetation.

Decreasers make up from 65 to 85 percent of the climax plant cover. Sand bluestem, indiangrass, switchgrass, sand lovegrass, prairie junegrass, and Canada wildrye are the main decreasers. Blue grama, little bluestem, needle-and-thread, prairie sandreed, sand dropseed, and sedges are the main increasers. Sand dropseed, blue grama, western ragweed, and annuals are the main invaders.

The total annual yield of air-dry forage on this range site normally is 3,500 pounds per acre, but it ranges from 3,000 pounds per acre in unfavorable years to 4,000 pounds per acre in favorable years.

Sandy Range Site

This site consists of nearly level to moderately sloping soils on uplands. These soils are in the Hord, Loretto, Nora, Ortello, Thurman, and Valentine series. The surface layer ranges from fine sandy loam to loamy fine sand, and the subsoil ranges from silt loam and fine sandy loam to loamy fine sand. These soils have a moderately rapid to rapid infiltration rate, and they are well drained to somewhat excessively drained. The infiltration rate and the drainage have been the dominant influence on the vegetation.

Decreasers make up from 70 to 85 percent of the climax plant cover. Sand bluestem, indiangrass, switchgrass, and needle-and-thread are the main

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decreasers. Little bluestem, prairie sandreed, blue grama, sand dropseed, and western wheatgrass are the main increasers. Blue grama, sand dropseed, sand paspalum, windmillgrass, and tumblegrass are the main invaders. The last grasses to disappear in deteriorated range are blue grama, sand dropseed, sand paspalum, and western wheatgrass.

The total annual yield of air-dry forage on this range site normally is 3,500 pounds per acre, but it ranges from 3,000 pounds per acre in unfavorable years to 4,000 pounds per acre in favorable years.

Silty Range Site

This site is made up of smoothly sloping soils on uplands. These soils are in the Belfore, Hord, Loretto, Moody, and Nora series. Their surface layer and subsoil range from loam to silty clay loam. These deep soils have a moderate to moderately slow infiltration rate, are well drained, and have high available water capacity. The depth, rate of infiltration, drainage, and available water capacity have been the dominant influences on the vegetation.

Decreasers make up from 65 to 70 percent of the climax plant cover. Big bluestem, little bluestem, indiangrass, and switchgrass are the main decreasers. Blue grama, buffalograss, side-oats grama, and western wheatgrass are the main increasers. Blue grama, buffalograss, western ragweed, blue verbena, and plains pricklypear are the main invaders.

The total annual yield of air-dry forage on this range site normally is 3,800 pounds per acre, but it ranges from 3,500 pounds per acre in unfavorable years to 4,500 pounds per acre in favorable years.

Limy Upland Range Site

This site is made up of gently sloping to steep soils on uplands and foot slopes. These soils are in the Crofton series. They are well drained, and they are slightly to strongly calcareous at or near the surface and in the subsoil. The surface layer and subsoil are silt loam. The good balance between the water supply and the limy soil condition has been the dominant influence on the vegetation.

Decreasers make up from 65 to 75 percent of the climax plant cover. Little bluestem, big bluestem, switchgrass, and indiangrass are the main decreasers. Blue grama, buffalograss, and side-oats grama are the main increasers. Blue grama, buffalograss, western ragweed, blue verbena, and plains pricklypear are the main invaders.

The total annual yield of air-dry forage on this range site normally is 3,000 pounds per acre, but it ranges from 2,000 pounds per acre in unfavorable years to 4,000 pounds per acre in favorable years.

Thin Loess Range Site

Loess hills and bluffs, the only mapping unit in this range site, is on uplands marked by many catsteps and slopes. Slopes are steep to very steep and generally exceed 30 percent. Some areas are colluvium. Some are deep, well-drained, silt loam that is moderately calcareous to strongly calcareous to or nearly to the surface. Steepness of slope, excessive runoff, lack of profile development, and a high content of lime have been the dominant influences on the vegetation.

Decreasers make up from 65 to 75 percent of the climax plant cover. Little bluestem, big bluestem, side-oats grama, switchgrass, and plains muhly are the main decreasers. Blue grama, sand dropseed, and western wheatgrass are the main increasers. Blue grama, sand dropseed, broom snakeweed, and annuals are the main invaders.

The total annual yield of air-dry forage on this range site normally is 2,500 pounds per acre, but it ranges from 2,000 pounds per acre in unfavorable years to 3,000 pounds per acre in favorable years.

Principles of Range Management

The chief objective in managing range is maintaining production in the areas that are in good or excellent condition and increasing production in the areas where the forage has been depleted. Practices therefore are needed that conserve soil and water and that encourage the growth of better native plants.

Grazing practices that maintain or improve the condition of the range are needed on all rangeland in the county. These practices are (1) proper range use, (2) deferred grazing, and (3) rotation-deferred grazing. Livestock can be distributed better and more uniform grazing obtained by correctly locating fences; by developing watering places, such as ponds and wells; and by placing salt in areas where grazing is desired.

On some sites the condition of the range can be improved by range seeding. This improvement can be obtained by seeding improved grasses or by seeding grasses of either wild or improved strains on soils suitable for range. Crofton silt loam, 17 to 30 percent slopes, eroded, is an example of a soil that is still being cultivated but that should be seeded to grasses. Suitable grasses for this soil are big bluestem, little bluestem, indiangrass, switchgrass, and side-oats grama (pl. II). On all areas grazing needs to be controlled to maintain a suitable composition of forage plants.

The native meadows in Boone County are somewhat limited to the Wet Land and Subirrigated range sites in the sandhill valleys and along Beaver Creek and Cedar River. Also a few areas of the gently sloping Thurman loamy fine sand adjacent to the sandhills is used for this purpose (pl. II).

WOODLAND AND WINDBREAKS[4/]

Native woodland in Boone County is mainly along the major drainageways. Most of the woodland is in narrow areas along the flood plains and the borders of the Cedar River and Beaver Creek on Inavale, Leshara, and associated soils.

Other narrow areas of native woodland are along Plum and Timber Creeks and their main tributaries on the Hobbs and Hord soils and on Silty alluvial land. The trees vary from stream to stream, but they generally are cottonwood, green ash, boxelder, American elm, and willow.

A small area in the Sand Creek watershed, south and east of Loretto supports an open stand of bur oak, on the high ground, and redcedar and American elm on the lower part.

Native trees and shrubs contribute much to the natural beauty of Boone County. They provide a few poles and posts and some firewood for local use. They are more important, however, as a source of food and cover for wildlife and as shelter for livestock.

Windbreak Suitability Groups

Windbreaks for protection of fields and farmsteads are the most important use of trees in Boone County. Windbreaks help to control soil blowing and drifting snow, provide shelter for livestock and wildlife, protect farm buildings and gardens, and provide many indirect benefits.

The best trees for most windbreak sites are the conifers, chiefly redcedar, Ponderosa pine, Austrian pine, and Rocky Mountain juniper. Several broadleaf trees and shrubs are suitable for windbreaks.

The rate of tree growth varies considerably depending upon the soils and the kinds of trees and shrubs planted. Rainfall, fertility, and available moisture capacity are important to growth. Some trees grow faster than others. Redcedar grows about a foot a year and reaches a height of 30 to 40 feet at maturity. Pines and broadleaf trees grow a little faster and a little taller. Some trees, cottonwood for example, grow fast but die young. Siberian elm grows fast but spreads where it is not wanted. American elm is a poor risk because of its susceptibility to Dutch elm disease.

Prior to planting, preparation of the planting site is necessary to good survival. In preparing the site, summer fallow alfalfa and grass sod at least a year prior to planting; fall plow, if feasible, or plow in early spring; and disc just prior to planting.

The use of locally suited trees of good quality is essential. Proper storage and handling of the trees also is important. Young trees need to be cultivated until they are large enough to form a canopy that will shade out weeds and grass. Survival of newly planted trees is better if cultivation is confined to tree rows and if the strips between the rows are planted to corn, milo, sudangrass, or similar tall cover crops. This practice prevents soil blowing and protects the trees from the hot sun and drying wind.

Information on the design, planting, and care of windbreaks is available from local technicians in the Soil Conservation Service and the Extension Service.

The soils of Boone County have been grouped according to their characteristics that affect the growth of trees. The windbreak group to which each soil belongs is shown in the "Guide to Mapping Units" at the back of this survey. All of the soils in the same windbreak suitability group have about the same capacity for supporting trees. In the following paragraphs the soils in each group are briefly described, and trees and shrubs suitable for planting in windbreaks on these soils are listed. Also the predicted growth of certain species based on actual measurement is given for several windbreak suitability groups.

Silty to Clayey Windbreak Suitability Group

This group consists of deep, well-drained, silty or clayey soils and of soils that have a claypan. Some areas of Slickspots are also in this group. Many of these soils are eroded.

Trees and shrubs suitable for planting are eastern redcedar, ponderosa pine, Austrian pine, Rocky Mountain juniper, Scotch pine, Colorado blue spruce, honeylocust, green ash, hackberry, bur oak, Russian mulberry, Russian-olive, lilac, honeysuckle, cotoneaster, chokecherry, three-leaved sumac, and Nemaha plum.

Green ash grows a little more than a foot per year on these soils, and plum about one-half foot per year.

Sandy Windbreak Suitability Group

In this group are fine sandy loams and loamy fine sands. These soils are nearly level to rolling. Many areas are eroded.

Trees and shrubs suitable for planting are eastern redcedar, Rocky Mountain juniper, ponderosa pine, Austrian Pine, Scotch pine, honeylocust, green ash, cottonwood, Russian mulberry, honeysuckle, three-leaved sumac, lilac, Nemaha plum, and American plum.

On these soils, green ash grows a little more than a foot a year, eastern redcedar about a foot a year, cottonwood about 2 feet a year, and mulberry slightly less than a foot a year.

4/ By JAMES W. CARR, JR., woodland conservationist, Soil Conservation Service.

Very Sandy Windbreak Suitability Group

This group consists of sandy soils and loose sands that cannot be cultivated without risk of erosion.

Trees suitable for planting are eastern redcedar, Rocky Mountain juniper, ponderosa pine, and Scotch pine.

Eastern redcedar grows about three quarters of a foot a year and ponderosa pine slightly over a foot a year on these soils.

Moderately Wet Windbreak Suitability Group

This group consists of soils on bottom lands and upland valleys that are wet occasionally because of a high water table or flooding.

Trees and shrubs suitable for planting are eastern redcedar, Scotch pine, Black Hills spruce, honeylocust, green ash, hackberry, golden willow, white willow, diamond willow, purple willow, catalpa, black walnut, Russian mulberry, Russian-olive, red-osier dogwood, buffaloberry and chokecherry.

Wet Windbreak Suitability Group

This group consists of soils on bottom lands and in depressions on uplands that are made extremely wet by a high water table and by short, frequent floods.

Trees and shrubs suitable for planting are golden willow, white willow, diamond willow, purple willow, cottonwood, and red-osier dogwood.

Not Plantable Windbreak Suitability Group

This group consists of soils that are not suited to trees because of excess wetness.

WILDLIFE AND RECREATION[5/]

The kinds and amounts of wildlife that can be produced and maintained in the county are largely determined by the kinds and amounts of vegetation that the soils can produce and by the way the vegetation is distributed

Wildlife is also influenced by topography and by such soil characteristics as fertility. Fertile soils are capable of greater wildlife production than less fertile soils, and waters that drain from fertile soils generally produce more fish than waters drained from infertile soils. Topography affects wildlife through its influence on land use. Extremely rough, irregular areas may present hazards to livestock, but the undisturbed vegetation in such areas is often valuable to wildlife. If suitable vegetation is lacking in such areas, it can often be developed to improve conditions for desirable kinds of wildlife.

Wetness and water-holding capacity of soils are important in selecting sites for constructing ponds for fish and in developing and maintaining habitats for waterfowl. Swampy and marshy areas lend themsleves to the development of aquatic and semiaquatic habitats of value to waterfowl and to some furbearers.

The soils of Boone County provide suitable habitats for many kinds of wildlife. Buffalo and wolves are no longer present but other species continue to be plentiful. Pheasant, deer, and bobwhite quail are important as game. Among the small animals in the county are raccoon, opossum, weasel, mink, muskrat, coyote, and skunk.

Many kinds of birds live in the county throughout the year. Waterfowl are primarily along the Cedar River and Beaver Creek. Birds that prefer a woody habitat also live along these streams and in farmstead and livestock windbreaks.

Channel catfish are the most important species of fish in the Cedar River and in other streams in the county. Sites suitable for developing ponds for production of fish are limited to areas in these valleys. In places the streams could be improved for fish.

The wildlife resources of the county are important primarily for the recreational opportunities they provide. Many species of wildlife are also beneficial in the control of rodents and undesirable insects.

The combination of soils, topography, and vegetation in the county provides opportunities for developing recreational facilities. Opportunities for combining recreational enterprises with farm and ranch operations could be explored. Many people are interested in typical farm and ranch operations and would like the opportunity to learn about and take part in such activities on a farm or ranch.

Increased travel by the American public also provides opportunities for using suitable soils for recreational purposes. Some areas along main highways through the county are suitable for developing sites for overnight camping facilities. These would be a real convenience to travelers and a source of additional income for landowners.

Recreation oriented around the fish and wildlife resources in the county would be primarily based on hunting and fishing. Many people, however, also enjoy wildlife for itself and would appreciate it if areas were provided where wildlife could be seen, heard, and photographed. If production of fish and wildlife for recreation is considered, the kinds of soils in an area will be an important factor in the success of the enterprise.

5/ By R. J. LEMAIRE, biologist, Soil Conservation Service.

In table 3 the potential of the soil associations in Boone County for producing habitats for wildlife are shown. The ratings of very good, good, and fair in the table take into account the kinds of soils in each association and their potential (shown in the column titled "Food") for producing the kind of vegetation needed for the various habitats. For more detailed information about the soil associations and their locations, refer to the section "General Soil Map" and to the map in the back of this survey. Further information about the soils can be found in the section "Descriptions of the Soils."

Technical assistance in planning wildlife habitat and in determining the kinds of plants needed can be obtained from the local office of the Soil Conservation Service. Information and assistance are also available from the Nebraska Game, Forestation, and Parks Commission, Bureau of Sports, Fisheries, and Wildlife, and from the Agricultural Extension Service.

TABLE 3.--POTENTIAL OF SOIL ASSOCIATIONS FOR PRODUCING HABITATS FOR THE MORE IMPORTANT WILDLIFE

Soil association	Wildlife	Potential for producing--			
		Woody cover	Herbaceous cover	Food	Aquatic environment
Valentine association---	Deer----------	Fair---------	Good---------	Fair---------	
Elsmere-Wann-Loup association.	Deer----------	Good---------	Good---------	Good--------	
	Furbearers--------	----------	----------	----------	Good.
	Waterfowl---------	----------	----------	----------	Good.
	Fish----------	----------	----------	----------	Good.
	Pheasant----------	Good---------	Good---------	Good--------	
	Bobwhite quail----	Good---------	Good---------	Good--------	
Thurman-Hord-Loretto association.	Deer----------	Fair---------	Good---------	Fair--------	
	Pheasant----------	Fair---------	Good---------	Fair--------	
Nora-Crofton-Moody association.	Deer----------	Fair---------	Good---------	Good--------	
	Pheasant----------	Fair---------	Good---------	Good--------	
Hobbs association-------	Deer----------	Good---------	Very good----	Very good---	
	Pheasant----------	Good---------	Very good----	Very good---	
	Bobwhite quail----	Good---------	Very good----	Very good---	
Hall-Hord association---	Deer----------	Good---------	Very good----	Very good---	
	Pheasant----------	Good---------	Very good----	Very good---	
	Bobwhite quail----	Good---------	Very good----	Very good---	
Belfore-Moody association.	Deer----------	Fair---------	Good---------	Good--------	
	Pheasant----------	Fair---------	Good---------	Good--------	
	Waterfowl---------	----------	----------	----------	Good.
Leshara-Lamo-Wann association.	Deer----------	Very good----	Good---------	Good--------	
	Pheasant----------	Very good----	Good---------	Good--------	
	Bobwhite quail----	Very good----	Good---------	Good--------	
	Furbearers--------	----------	----------	----------	Good.
	Waterfowl---------	----------	----------	----------	Good.
	Fish----------	----------	----------	----------	Good.

ENGINEERING USES OF THE SOILS[6/]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of highways and roads, airports, pipelines, building foundations, facilities for storing water and controlling erosion, and systems for irrigating and draining soils and for disposing of sewage. Among the properties most important to engineers are soil texture, permeability, shear strength, plasticity, reaction, compaction characteristics, and available water capacity. Also important are relief, depth to the water table, and depth to bedrock or to sand and gravel. Such information is made available in this subsection. Engineers can use it to--

1. Make studies that will aid in selecting and developing sites for industries, businesses, residences, and recreational areas.
2. Make estimates of engineering properties of soils that will help in planning agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, waterways, and other structures for conserving soil and water.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, cables, and sewage disposal fields and in planning more detailed investigations at selected locations.
4. Estimate the size of drainage areas and the speed and volume of runoff in designing culverts and bridges.
5. Identify the soils along proposed routes for highways for use in making preliminary estimates of the thickness required for flexible pavements.
6. Estimate the amount of clay needed to stabilize the surface of unpaved roads.
7. Locate deposits of sand, gravel, rock, mineral filler, and soil binder for use in constructing subbase courses, base courses, and surface courses of flexible pavements.
8. Make preliminary evaluations of the relief, surface drainage, subsurface drainage, height of water table, and other features that effect the design of highway embankments, subgrades, and pavements.
9. Correlate performance of engineering structures with soil mapping units and thus develop information that can be used in designing and maintaining these structures.
10. Determine the suitability of the soils for cross-country movement of vehicles and construction equipment.
11. Supplement information from other published maps and surveys for the purpose of making maps and reports that can be used readily by engineers.
12. Develop other preliminary estimates for construction purposes pertinent to the area.

With the use of the soil map for identification, the engineering interpretations reported here can be useful for many purposes. It should be emphasized that they do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads or excavations deeper than the depth of layers here reported. Even in such situations, the soil map is useful for planning more detailed field investingations and for suggesting the kinds of problems that can be expected.

The soil mapping units shown on the maps in this survey may include small areas of different soil material. These included soils may be as much as 2 acres in size. They are too small to be mapped separately and generally are not significant to the farming in the area but may be important in engineering planning.

Information of value in planning engineering work is given throughout the text, particularly in the sections "Descriptions of the Soils" and "Formation and Classification of Soils."

Some of the terms used by the scientist may be unfamiliar to the engineer, and some words--for example, clay, sand, and silt--may have special meaning in soil science. These and other special terms used in the soil survey are defined in the Glossary at the back of this survey. Most of the information about engineering is given in tables 4, 5, and 6.

Engineering Classification Systems

Two systems of classifying soils are in general use by engineers. One is the system used by the American Association of State Highway Officials (AASHO) (1), and the other is the Unified system, which was developed by the U.S. Army Corps of Engineers, U.S. Department of Defense (9). Estimated classifications of all the soils according to these two systems and according to the textural classification used by the U.S. Department of Agriculture are shown in table 5.

The AASHO system is based on field performance and on gradation, liquid limit, and plasticity index. In this system soil materials are placed in seven groups, ranging from A-1 through A-7. Soils in the A-1 group are gravelly and have high bearing capacity; those in the A-7 group are clayey and have low bearing capacity when wet. The relative engineering values of the soils within each group are indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. The group index of a soil can be established only by laboratory tests. The AASHO classifications in table 4 include group index numbers for the soils tested.

The Unified system is based on the texture and plasticity of the soils, as well as on their performance. Three soil fractions are recognized--gravel,

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6/ By SYDNEY H. HAAKENSTAD, area engineer, and CHARLES L. HAMMOND, soil scientist, with the assistance of LEE E. SMEDLEY, assistant State conservation engineer; all of the Soil Conservation Service.

sand, and fines (silt and clay). Soils are classified as coarse grained (eight classes), fine grained (six classes), and highly organic (one class), according to their content of the three soil fractions. A letter symbol indicates the principal characteristics of the soils. The coarse-grained soils are gravel (G) and sand (S), and each of these is divided into four secondary groups. The fine-grained soils are silt (M) and clay (C), depending on their liquid limit and plasticity index. The silt and clay groups are each divided into secondary groups according to whether the soils have low (L) or high (H) liquid limit. The highly organic soils (Pt) are generally very compressible and have undesirable characteristics for construction purposes.

Engineering Test Data

Table 4 shows engineering test data for 12 soil types that were sampled and tested by the Division of Materials and Tests, Nebraska Department of Roads. The samples taken were of natural horizons.

Each soil type listed in table 4 was sampled at only one location, and the data given for the soil are those at that location. From one location to another, a soil may differ considerably in characteristics that affect engineering. Even where the soils are sampled at more than one location, the test data probably do not show the widest range in characteristics.

Moisture-density data in table 4 were obtained by mechanical compaction. If soil material is compacted at successively higher moisture content and the compaction effort remains constant, the density of the compacted material increases until the optimum moisture content is reached. After that the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is the maximum dry density. Moisture-density data are important in earthwork, for, as a rule, soil is most stable if it is compacted to the maximum dry density when it is at the optimum moisture content.

The mechanical analysis was made by a combination of the sieve and hydrometer methods. The percentages of clay obtained by the hydrometer method should not be used in naming textural classes of soils. The classifications in the last two columns of table 4 are based on data obtained by mechanical analysis and on tests made to determine liquid and plastic limits.

The tests for liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state and from a plastic to a liquid state. The plastic limit is the moisture content, expressed as a percentage of the oven-dry weight, at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates a range of moisture content within which a soil material is in a plastic condition. Some silty and sandy soils are nonplastic; they do not become plastic at any moisture content.

Estimated Engineering Properties

Table 5 shows estimated engineering properties of the soils based on test data in table 4 and on information given in other sections of this publication.

The data in table 5 are listed by layers that have properties significant to engineering. These data include the textural classification of the United States Department of Agriculture and the AASHO and Unified engineering classifications. Also listed for each layer are the percentages of material that will pass a No. 10 sieve and a No. 200 sieve.

Permeability is the quality that enables a soil to transmit water and air. It depends upon the texture and structure of the soil. It is expressed as the rate at which water percolates through undisturbed soil material and is measured in inches per hour.

Available water capacity, expressed in inches of water per inch of soil depth, is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of water in a soil at field capacity and the amount at wilting point.

Shrink-swell potential generally depends on the texture of a soil. The shrink-swell potential is high for plastic soils that have a high clay content and low to moderate for soils that have an intermediate content of silt and clay. Nonplastic soils with no potential change in volume are rated as none. The low to moderate ratings of some soils were obtained by comparing the soils with other of known mechanical analysis plasticity ratings.

Table 5 does not give the reaction of soils in the county. The reaction generally ranges from pH 6.1 to 7.4 in the surface layer and from pH 7.5 to 8.5 in the lower layers. In most of the soils, the content of soluble salts is 0.2 percent or less. A few somewhat poorly drained, fine-textured soils, however, have a pH that ranges from 8.2 to 8.8.

Dispersion generally is not a problem, but in the Slickspots part of the Hall-Slickspots complex, the rate of dispersion is high.

Engineering Interpretations of the Soils

In table 6 the soils are rated as sources of topsoil and sand and as material for road subgrade and fill. Soil features are named that affect highway location, foundations, dikes and levees, low dams, drainage systems, irrigation systems, waterways, and terraces. Also listed are soil limitations for sewage disposal systems.

TABLE 4.--ENGINEERING

[Tests performed by the Nebraska Department of Roads in cooperation with the U.S. Department of Commerce, Highway Officials

Soil name and location	Parent material	Nebraska report No. S62	Depth	Moisture-density data 1/	
				Maximum dry density	Optimum moisture
			In.	Lb. per cu. ft.	Pct.
Belfore silt loam: 450 feet N. and 0.2 mile W. of E. quarter corner sec. 27, T. 21 N., R. 5 W. (Modal)	Peoria loess.	7844 7845 7846	0-5 26-38 50-62	100 101 102	20 21 21
Crofton silt loam: 850 feet S. and 0.35 mile W. of NE. corner sec. 32, T. 20 N., R. 6 W. (Modal)	Peoria loess.	7836 7837	0-4 7-60	93 105	25 19
Hall silt loam: 450 feet E. and 290 feet N. of SW. corner sec. 33, T. 19 N., R. 5 W. (Modal)	Peoria loess.	7852 7853 7854	0-6 22-36 41-60	101 98 102	20 23 20
Hobbs silt loam: 210 feet S. and 185 feet W. of NE. corner sec. 16, T. 22 N., R. 5 W. (Modal)	Silty alluvium.	7834 7835	6-18 18-44	98 95	23 24
Hord silt loam, terrace: 100 feet E. and 0.25 mile N. of SW. corner sec. 7, T. 20 N., R. 6 W. (Modal)	Old alluvium and loess.	7831 7832 7833	0-7 16-34 42-60	101 105 104	20 18 19
Lamo silty clay loam: 100 feet N. and 0.15 mile E. of S. quarter corner sec. 21, T. 19 R. 5 W. (Modal)	Silty alluvium.	7828 7829 7830	6-15 22-37 42-63	92 92 100	24 26 21
Leshara silt loam: 0.1 mile W. and 0.1 mile N. of E. quarter corner sec. 31, T. 22 N., R. 7 W. (Modal)	Alluvium.	7849 7850 7851	0-10 28-38 45-60	105 110 112	17 16 13
Moody silty clay loam: 150 feet S. and 0.1 mile E. of NW. corner sec. 9, T. 22 N., R. 6 W. (Modal)	Peoria loess.	7855 7856 7857	0-7 11-27 36-60	98 98 103	21 20 21

See footnotes at end of table.

TEST DATA

Bureau of Public Roads (BPR) in accordance with standard procedures of the American Association of State (AASHO)(1)]

Mechanical analysis 2/							Liquid limit	Plasticity index	Classification	
Percentage passing sieve--			Percentage smaller than--							
No 10 (2.0 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO	3/ Unified
							Pct.			
---	100	99	90	50	30	23	38	15	A-6(10)	ML-CL
---	100	99	91	60	41	33	45	24	A-7-6(15)	CL
---	---	100	93	56	39	32	49	28	A-7-6(17)	CL
100	99	98	84	43	27	19	46	17	A-7-6(12)	ML
---	100	99	88	42	23	16	36	13	A-6(9)	ML-CL
---	100	98	81	44	27	22	35	13	A-6(9)	ML-CL
---	100	99	85	57	41	36	55	32	A-7-6(19)	CH
---	100	99	88	48	31	24	39	17	A-6(11)	CL
---	100	99	80	49	30	24	42	18	A-7-6(12)	ML-CL
---	100	99	89	61	40	31	47	22	A-7-6(14)	CL
---	100	97	86	42	27	22	39	17	A-6(11)	CL
---	100	96	79	31	23	19	36	13	A-6(9)	ML-CL
---	100	97	82	43	26	20	39	17	A-6(11)	CL
---	100	97	91	53	32	22	46	18	A-7-6(12)	ML-CL
100	98	95	88	66	46	38	60	35	A-7-6(20)	CH
100	98	96	89	61	39	32	50	30	A-7-6(18)	CL
100	98	77	56	27	17	14	33	10	A-4(8)	ML-CL
100	99	83	66	26	18	14	31	9	A-4(8)	ML-CL
---	100	63	31	14	8	7	22	1	A-4(6)	ML
---	100	98	84	50	35	29	43	20	A-7-6(13)	CL
---	100	99	90	57	40	33	49	27	A-7-6(17)	CL
---	100	99	90	46	29	22	41	18	A-7-6(11)	CL

Soil name and location	Parent material	Nebraska report No. S62	Depth	Moisture-density data 1/	
				Maximum dry density	Optimum moisture
			In.	Lb. per cu. ft.	Pct.
Nora silt loam:					
300 feet S. and 450 feet E. of NW. corner sec. 17, T. 20 N., R. 5 W. (Modal)	Peoria loess.	7819	0-5	94	23
		7820	16-29	104	20
		7821	29-45	105	19
Thurman loamy fine sand:					
65 feet S. and 0.1 mile W. of E. quarter corner sec. 20, T. 21 N., R. 8 W. (Modal)	Eolian sand.	7825	7-17	118	12
		7826	17-23	117	11
		7827	23-60	115	12
Valentine fine sand:					
180 feet E. and 0.2 mile N. of W. quarter corner sec. 13, T. 22 N., R. 8 W. (Modal)	Eolian sand.	7817	0-4	110	12
		7818	7-60	108	12
Wann loam:					
25 feet S. and 0.1 mile E. of NW. corner sec. 4, T. 21 N., R. 7 W. (Modal)	Sandy alluvium.	7822	5-17	115	12
		7823	17-22	117	11
		7824	43-54	108	13

1/ Based on AASHO Designation: T 99-57, Method A (1).

2/ Mechanical analyses according to the AASHO Designation T 88-57 (1). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material including that coarser than 2 millimeters in diameter. In the SCS procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes.

TEST DATA--Continued

Mechanical analysis 2/							Liquid limit	Plasticity index	Classification	
Percentage passing sieve--			Percentage smaller than--						AASHO	Unified 3/
No. 10 (2.0 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
							Pct.			
---	100	99	90	54	34	29	47	21	A-7-6(14)	ML-CL
---	100	99	91	50	30	23	40	17	A-6(11)	CL
100	99	99	91	52	31	22	38	15	A-6(10)	ML-CL
100	90	37	26	15	9	8	(4/)	(4/)	A-4(0)	SM
100	87	28	18	10	7	6	(4/)	(4/)	A-2-4(0)	SM
100	79	18	12	8	6	6	(4/)	(4/)	A-2-4(0)	SM
100	74	14	10	6	4	4	(4/)	(4/)	A-2-4(0)	SM
100	79	7	6	5	4	3	(4/)	(4/)	A-3(0)	SP-SM
100	90	37	26	14	7	6	(4/)	(4/)	A-4(0)	SM
100	89	25	18	10	6	5	(4/)	(4/)	A-2-4(0)	SM
100	96	19	10	5	4	3	(4/)	(4/)	A-2-4(0)	SM

3/ SCS and BPR have agreed that all soils having plasticity indexes within 2 points of A-line are to be given a borderline classification, such as ML-CL.

4/ Nonplastic.

TABLE 5.--ESTIMATED ENGINEERING

Map symbol	Soil	Underlying material 1/	Depth to water table	Depth to sand	Depth from surface
			Feet	Feet	Inches
Be	Belfore silt loam, 0 to 1 percent slopes.	Silt (Peoria loess)---	(2/)	(3/)	0-12 12-49 49-60
B	Blown-out land.	Wind-laid sand--------	(2/)	5-8	0-60
Cz	Cass soils.	Alluvial sand---------	6-15	3-8	0-13 13-19 19-60
CfD2	Crofton silt loam, 7 to 17 percent slopes, eroded. 4/	Silt (Peoria loess)---	(2/)	(3/)	0-60
CfE2	Crofton silt loam, 17 to 30 percent slopes, eroded.				
CNC2	Crofton-Nora silt loams, 7 to 12 percent slopes, eroded. (See Nora soil for Nora part.)				
CND2	Crofton-Nora silt loams, 12 to 17 percent slopes, eroded. (See Nora soil for Nora part.)				
CNE	Crofton-Nora silt loams, 17 to 30 percent slopes. (See Nora soil for Nora part.)				
Eb	Elsmere fine sand.	Wind-laid sand--------	2-6	3-10	0-10 10-60
Ea	Elsmere loamy fine sand.	Wind-laid sand-------	2-6	3-10	0-18 18-60
Fm	Fillmore silt loam.	Silt (Peoria loess)---	(2/)	(3/)	0-20 20-58 58-60
Ga	Gannett fine sandy loam.	Wind-laid sand-------	0-2	6-20	0-10 10-60

Classification			Percentage passing sieve--		Permeability	Available water capacity	Shrink-swell potential
Dominant USDA texture	Unified	AASHO	No. 10	No. 200			
					Inches per hour	Inches per inch of soil	
Silt loam to silty clay loam.	ML to CL	A-6	100	90-100	0.2-2.0	0.18-0.19	Moderate.
Silty clay loam---	CL or CH	A-6 or A-7	100	90-100	0.2-0.63	0.18-0.16	High.
Silty clay loam---	CL	A-6 or A-7	100	90-100	0.2-0.63	0.18	Moderate.
Fine sand---------	SP or SP-SM	A-3	100	0-10	6.3-10.0	0.06-0.08	Low to none.
Fine sandy loam to silt loam.	ML or CL	A-4	100	50-75	0.63-6.3	0.16-0.19	Low to moderate.
Fine sandy loam---	SM	A-2 or A-4	100	25-50	2.0-6.3	0.10-0.12	Low.
Fine sand---------	SP or SP-SM	A-3	100	0-10	6.3-10.0	0.06-0.08	Low to none.
Silt loam---------	ML to CL	A-4 or A-6	100	80-100	0.63-2.0	0.19	Low to moderate.
Fine sand---------	SP-SM or SM	A-3 or A-2	100	10-20	6.3-10.0	0.06-0.08	Low to none.
Fine sand---------	SP-SM or SM	A-3 or A-2	100	4-20	6.3-10.0	0.06-0.08	Low to none.
Loamy fine sand---	SM	A-2	100	15-35	6.3-10.0	0.10	Low to none.
Fine sand---------	SP-SM or SM	A-3 or A-2	100	4-20	6.3-10.0	0.06-0.08	Low to none.
Silt loam---------	ML or CL	A-4 or A-6	100	85-95	0.63-2.0	0.19	Low.
Silty clay to clay.	CH	A-7	100	90-100	0.06-0.2	0.16-0.12	High.
Silty clay loam---	CL	A-6 or A-7	100	85-100	0.2-2.0	0.19-0.18	Low to moderate.
Fine sandy loam to loam.	SM	A-4	100	36-50	0.63-6.3	0.18-0.16	Low.
Loamy fine sand to find sand.	SP-SM or SM	A-3 or A-2	100	5-30	6.3-10.0	0.06-0.08	Low.

Map symbol	Soil	Underlying material 1/	Depth to water table	Depth to sand	Depth from surface
			Feet	Feet	Inches
Ha	Hall silt loam, 0 to 1 percent slopes. 4/	Silt (loess or alluvium).	6-20	(3/)	0-13 13-44 44-60
HaA	Hall silt loam, 1 to 3 percent slopes.				
HSzA	Hall-Slickspots complex, 1 to 3 percent slopes.				
Hb	Hobbs silt loam, 0 to 1 percent slopes.	Stratified silt-------	(2/)	(3/)	0-18 18-60
2Hb	Hobbs silt loam, 0 to 1 percent slopes, occasionally flooded.	Stratified silt-------	(2/)	(3/)	0-18 18-60
Hd	Hord silt loam, 0 to 1 percent slopes. 4/	Silt (Peoria loess)---	(2/)	(3/)	0-60
HdA	Hord silt loam, 1 to 3 percent slopes.				
HdB	Hord silt loam, 3 to 7 percent slopes.				
2Hd	Hord silt loam, terrace, 0 to 1 percent slopes. 4/	Stratified silt-------	6-20	(3/)	0-42 42-60
2HdA	Hord silt loam, terrace, 1 to 3 percent slopes.				
HO	Hord and Ortello fine sandy loams, 1 to 3 percent slopes. 5/	Stratified silt and sand.	6-20	(3/)	0-31 31-60
Iz	Inavale soils.	Alluvial sand---------	5-10	3-8	0-8 8-60
2Iz	Inavale soils, wet.	Alluvial sand---------	2-6	3-8	0-10 10-60
Lb	Lamo silty clay loam.	Stratified silt-------	2-6	6-10	0-15 15-42 42-63
Le	Leshara silt loam.	Stratified silt and sand.	3-6	4-8	0-13 13-34 34-60

See footnotes at end of table.

PROPERTIES OF THE SOILS--Continued

Classification			Percentage passing sieve--		Permeability	Available water capacity	Shrink-swell potential
Dominant USDA texture	Unified	AASHO	No. 10	No. 200			
					Inches per hour	Inches per inch of soil	
Silt loam---------	ML to CL	A-4 or A-6	100	90-100	0.63-2.0	0.18	Low to moderate.
Silty clay loam---	CL or CH	A-6 or A-7	100	90-100	0.2-0.63	0.19	Moderate to high.
Silt loam---------	CL	A-6	100	90-100	0.63-2.0	0.18	Low to moderate.
Silt loam---------	ML to CL	A-4 or A-6	100	90-100	0.63-2.0	0.19	Low to moderate.
Silt loam---------	ML to CL	A-6 or A-7	100	90-100	0.63-2.0	0.19	Moderate.
Silt loam---------	ML to CL	A-4	100	90-100	0.63-2.0	0.19	Low.
Silt loam---------	ML to CL	A-6 or A-7	100	90-100	0.63-2.0	0.19	Moderate.
Silt loam---------	ML or CL	A-4 or A-6	100	90-100	0.63-2.0	0.19	Low to moderate.
Silt loam---------	ML or CL	A-4 or A-6	100	80-100	0.63-2.0	0.19	Low to moderate.
Silt loam---------	ML or CL	A-4 or A-6	100	55-90	0.63-2.0	0.19	Low to moderate.
Fine sandy loam---	SM or ML	A-4, A-2	100	25-55	2.0-6.3	0.10	Low.
Silt loam---------	ML to CL	A-4 or A-6	100	60-90	0.63-2.0	0.19	Low to moderate.
Fine sandy loam to loamy sand.	SM	A-2 or A-4	100	30-50	2.0-10.0	0.10	Low.
Loamy fine sand to fine sand.	SM or SP-SM	A-3 or A-2	100	5-30	6.3-10.0	0.06-0.08	Low to none.
Loam to fine sandy loam.	SM or ML	A-4	100	40-90	0.63-6.3	0.18-0.16	Low.
Fine sand---------	SP-SM or SM	A-3 or A-2	100	5-20	6.3-10.0	0.06-0.08	Low to none.
Silty clay loam---	CL	A-6 or A-7	100	95-100	0.2-0.63	0.18	Moderate to low.
Silty clay loam---	CL to CH	A-7	100	95-100	0.2-0.63	0.18	Moderate to high.
Silty clay loam---	CL	A-6 or A-7	100	95-100	0.2-0.63	0.18	Moderate.
Silt loam---------	ML or CL	A-4	100	75-90	0.63-2.0	0.19	Low.
Silt loam---------	ML	A-4	100	75-90	0.63-2.0	0.19	Low.
Very fine sandy loam.	ML	A-4	100	60-90	0.63-2.0	0.19-0.18	Low.

TABLE 5.--ESTIMATED ENGINEERING

Map symbol	Soil	Underlying material [2/]	Depth to water table	Depth to sand	Depth from surface
			Feet	Feet	Inches
Lh	Loess hills and bluffs.	Silt (Peoria loess)----	(2/)	(3/)	0-60
LvA2	Loretto fine sandy loam, 0 to 3 percent slopes, eroded. [4/]	Silt (Peoria loess)----	(2/)	(3/)	0-18 18-60
LvB2	Loretto fine sandy loam, 3 to 7 percent slopes, eroded.				
L1B2	Loretto loam, 3 to 7 percent slopes, eroded.				
LNC2	Loretto-Nora fine sandy loams, 7 to 12 percent slopes, eroded. (See Nora soil for Nora part.)				
Lm	Loup loam.	Alluvial sand----------	0-2	3-8	0-10 10-60
M	Marsh. [6/]	Stratified silt and sand.			
MoA	Moody silty clay loam, 1 to 3 percent slopes.	Silt (Peoria loess)----	(2/)	(3/)	0-12 12-48 48-60
MoA2	Moody silty clay loam, 1 to 3 percent slopes, eroded.				
MoB2	Moody silty clay loam, 3 to 7 percent slopes, eroded. [4/]	Silt (Peoria loess)----	(2/)	(3/)	0-8 8-36 36-60
NoC	Nora silt loam, 7 to 12 percent slopes.	Silt (Peoria loess)----	(2/)	(3/)	0-7 7-29 29-60
NoC2	Nora silt loam, 7 to 12 percent slopes, eroded. [4/]				
NCD	Nora-Crofton silt loams, 12 to 17 percent slopes. (See Crofton soil for Crofton part.)				
NMB2	Nora-Moody complex, 3 to 7 percent slopes, eroded. (See Moody soil for Moody part.)				
Sx	Sandy alluvial land. [6/]	Alluvial sand----------	(2/)	3-8	
Sy	Silty alluvial land. [6/]	Alluvial silt --------	(2/)	(3/)	

See footnotes at end of table.

PROPERTIES OF THE SOILS--Continued

Classification			Percentage passing sieve--		Permeability	Available water capacity	Shrink-swell potential
Dominant USDA texture	Unified	AASHO	No. 10	No. 200			
					Inches per hour	Inches per inch of soil	
Silt loam---------	ML to CL	A-4 or A-6	100	90-100	0.63-2.0	0.19	Low to moderate.
Loam to fine sandy loam.	SM to CL	A-2 or A-4	100	25-70	0.63-6.3	0.18-0.12	Low.
Silt loam----------	ML to CL	A-4 or A-6	100	75-100	0.63-2.0	0.19	Low to moderate.
Loam--------------	ML	A-4	100	55-75	0.63-2.0	0.18	Low.
Fine sand---------	SP or SP-SM	A-3	100	0-10	6.3-10.0	0.06-0.08	Low to none.
Silty clay loam---	ML or CL	A-6 or A-7	100	90-100	0.2-0.63	0.18	Moderate.
Silty clay loam---	CL or CH	A-7	100	90-100	0.2-0.63	0.18	Moderate.
Silty clay loam---	ML or CL	A-6 or A-7	100	90-100	0.2-0.63	0.18	Moderate.
Silty clay loam---	CL or CH	A-6 or A-7	100	90-100	0.2-0.63	0.18	Moderate.
Silty clay loam---	CL or CH	A-7	100	90-100	0.2-0.63	0.18	Moderate.
Silt loam---------	CL	A-6 or A-7	100	90-100	0.63-2.0	0.19	Moderate.
Silt loam---------	ML to CL	A-6	100	75-100	0.63-2.0	0.19	Moderate.
Silt loam---------	CL	A-6 or A-7	100	75-100	0.63-2.0	0.19-0.18	Low to moderate.
Silt loam---------	ML to CL	A-6	100	75-100	0.63-2.0	0.19	Low to moderate.

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Map symbol	Soil	Underlying material 2/	Depth to water table	Depth to sand	Depth from surface
			Feet	Feet	Inches
ThA	Thurman loamy fine sand, 0 to 3 percent slopes. 4/	Wind-laid sand--------	(2/)	5-10	0-17 17-23 23-60
ThB	Thurman loamy fine sand, 3 to 7 percent slopes.				
ThC	Thurman loamy fine sand, 7 to 12 percent slopes.				
2ThA	Thurman loamy fine sand, silty substratum, 0 to 3 percent slopes.	Silt (Peoria loess)---	(2/)	(3/)	0-17 17-31 31-60
5ThA	Thurman loamy fine sand, terrace, 0 to 3 percent slopes.	Wind-laid sand--------	5-10	5-10	0-17 17-23 23-60
TV	Thurman-Valentine complex, 0 to 3 percent slopes. (See Valentine soil for Valentine part.)				
VaC	Valentine fine sand, rolling. 4/	Wind-laid sand--------	(2/)	3-6	0-4 4-60
Vb	Valentine loamy fine sand, undulating.				
Wm	Wann loam.	Alluvial sand---------	2-6	5-8	0-17 17-22 22-60
Wx	Wet alluvial land.	Stratified silt-------	0-2	5-8	0-60

1/ Materials generally at a depth between 4 and 10 feet.

2/ Extremely deep water table.

3/ Sand and gravel occur below the depth sampled.

4/ Classification and properties are for this phase. Soils in this group are nearly uniform in properties listed except for runoff, slope, degree of erosion, and alkalinity.

PROPERTIES OF THE SOILS--Continued

Classification			Percentage passing sieve--		Permeability	Available water capacity	Shrink-swell potential
Dominant USDA texture	Unified	AASHO	No. 10	No. 200			
					Inches per hour	Inches per inch of soil	
Loamy fine sand---	SM	A-2 or A-4	100	25-50	6.3-10.0	0.10	Low.
Loamy fine sand---	SM	A-2	100	25-35	6.3-10.0	0.10	Low.
Fine sand or loamy fine sand.	SP-SM or SM	A-3 or A-2	100	5-35	6.3-10.0	0.06-0.08	Low to none.
Loamy fine sand---	SM	A-2 or A-4	100	25-50	6.3-10.0	0.10	Low.
Loamy fine sand---	SM	A-2 or A-4	100	25-40	6.3-10.0	0.10	Low.
Silt loam---------	ML to CL	A-4 or A-6	100	60-90	0.63-2.0	0.19	Low to moderate.
Loamy fine sand---	SM	A-2 or A-4	100	25-50	6.3-10.0	0.10	Low.
Loamy fine sand---	SM	A-2	100	25-35	6.3-10.0	0.10	Low.
Fine sand or loamy fine sand.	SP-SM or SM	A-3 or A-2	100	5-35	6.3-10.0	0.06-0.08	Low to none.
Fine sand---------	SP-SM or SM	A-3 or A-2	100	5-25	6.3-10.0	0.08-0.10	Low.
Fine sand---------	SP or SP-SM	A-3	100	2-12	6.3-10.0	0.06-0.08	Low to none.
Loam to fine sandy loam.	SM or ML	A-4, A-2	100	30-75	0.63-6.3	0.16-0.17	Low.
Fine sandy loam---	SM	A-4, A-2	100	25-50	2.0-6.3	0.16	Low.
Loamy fine sand to fine sand.	SP, SP-SM or SM	A-3 or A-2	100	3-20	6.3-10.0	0.10-0.08	Low to none.
Silt loam or silty clay loam.	ML, CL or CH	A-4, A-6 or A-7	100	80-100	0.2-2.0	0.19-0.18	Low to moderate.

5/ Classification and properties are for the Ortello soil. For classification and properties of Hord soil, see Hord silt loam, 0 to 1 percent slopes.

6/ Classification and properties too variable to rate.

TABLE 6.--ENGINEERING

[Not included in this table, because their characteristics are too variable to be estimated,

Soil series and map symbols	Suitability--					Soil properties affecting--	
	As source of--		Of material for--			Highway location	Foundations 1/
	Topsoil	Sand	Road subgrade		Road fill		
			Paved	Gravel			
Belfore: Be	Good	(2/)	Poor	Good	Fair to poor	High susceptibility to frost action; erodibility of slopes.	Fair to poor bearing capacity.
Blown-out land: B	Very poor	Good for fine sand, generally below a depth of 1 foot.	Good	Poor	Good	Subject to soil blowing; slopes need protection; loose fine sand hinders hauling operations in places.	Good to fair bearing capacity, depending on density.
Cass: Cz	Fair to good	Fair for fine sand below a depth of 4 feet.	Fair to poor	Fair to good	Good to fair	Subject to occasional flooding; needs 4 to 7 feet of fill in places; moderate to high susceptibility to frost action.	Good to poor bearing capacity.
Crofton: CfD2, CfE2, CNC2, CND2, CNE. (For Nora part of mapping units CNC2, CND2, and CNE, refer to Nora series in this table.)	Good	(2/)	Fair to poor	Good to fair	Fair to poor	High susceptibility to frost action; erodibility of slopes; high cuts and fills required in places.	Fair to poor bearing capacity.
Elsmere: Ea, Eb	Fair to poor	Poor to fair for fine sand below a depth of 3 feet.	Good to fair	Fair to poor	Good to fair	Erodibility of slopes; slopes require protection in places; low susceptibility to frost action; high water table; 4 to 7 feet of fill required in places.	Good to fair bearing capacity depending on density.
Fillmore: Fm	Good to fair	(2/)	Fair to poor	Good to fair	Fair to poor	Moderate erodibility of slopes; ponding of water on surface; minimum fill required in places; high susceptibility to frost action.	Good to poor bearing capacity.
Gannett: Ga	Fair to poor	Good to fair for fine sand below a depth of 2 feet.	Poor to fair	Good to fair	Good to fair	High water table; ponding; minimum fill required in places; moderate susceptibility to frost action; slopes need protection in places.	Good to poor bearing capacity, depending on density; wet in places.
Hall: Ha, HaA, HSzA (Slickspots part of mapping unit HSzA requires onsite evaluation.)	Good	(2/)	Fair to poor	Good to fair	Fair to poor	High susceptibility to frost action; erodibility of slopes.	Fair to poor bearing capacity.
Hobbs: Hb, 2Hb	Good	(2/)	Fair to poor	Good to fair	Fair to poor	High to very high susceptibility to frost action; flooding, minimum fill needed in places; erodibility of slopes.	Good to poor bearing capacity; susceptible to liquefaction.

See footnotes at end of table.

are the land types Marsh (M), Sandy alluvial land (Sx), and Silty alluvial land (Sy)]

Soil properties affecting--Continued								
Dikes and levees	Low dams		Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Soil limitations for sewage disposal	
	Reservoir	Embankment					Septic tank and filter fields	Sewage lagoons
(3/)----------	Generally low seepage.	Fair to good stability; erodibility of slopes.	Generally good internal and surface drainage.	High available water capacity.	Erodibility of diversion slopes.	Moderate erodibility.	Severe: moderately slow permeability.	Slight.
(3/)----------	High seepage--	Erodibility of slopes; slopes need protection.	Well drained-----	(3/)----------	(3/)----------	(3/)----------	Severe: slopes.	Severe: rapid permeability; slopes.
Erodibility; flat slopes in places; moderate to high piping hazard.	Moderate to high seepage if substratum is exposed.	Fair to good stability; toe drains needed in places; fair to good workability.	Subject to overflow and seasonal high water table in places.	Moderate to low available water capacity; protection from overflow needed in places; adequate drainage needed.	(3/)----------	(3/)----------	Severe: subject to overflow.	Moderate to severe: moderately rapid permeability; protection from overflow needed in places.
(3/)----------	Slow to moderate seepage.	Poor to good stability; fair to good workability; close control needed in places.	Good internal drainage; surface drainage excessive in places.	High available water capacity.	Erodibility of slopes; steep and irregular slopes make alignment difficult in places.	Erodibility of slopes; maintenance costly on some steep slopes.	Slight on nearly level slopes; moderate to severe on slopes of more than 10 percent.	Moderate: moderate permeability. Severe on slopes of more than 7 percent.
Erodibility of slopes; protection required in places; subject to piping in places.	Moderate to rapid seepage.	Good to fair stability; wet in places; good to fair workability.	Good internal drainage; seasonally high water table.	Low available water capacity; adequate drainage needed.	(3/)----------	(3/)----------	Moderate to severe: high water table.	Severe: rapid permeability.
Moderate erodibility of slopes; cracks when dry in places.	Low seepage---	Good to poor stability; fair workability; impervious; erodibility on slopes.	Subject to ponding; slow internal drainage; adequate outlets not available in places.	High available water capacity; slow intake rate; drainage needed.	Erodibility of diversion slopes.	(3/)----------	Severe: slow permeability; subject to ponding.	Slight.
Erodibility; subject to piping in places.	Moderate seepage; can be dugouts in outs in places.	Erodibility of slopes; fair stability; subject to piping in places.	Fair to good internal drainage; adequate outlets not available in places to prevent ponding or for subsurface drains.	Low to moderate available water capacity; adequate drainage needed.	(3/)----------	(3/)----------	Severe: ponding.	Severe: high water table; ponding.
Erodibility; cracks when dry in places.	Low seepage---	Good to poor stability; fair to good workability.	Fair to good internal drainage.	High available water capacity; deep.	Erodibility of slopes.	Moderate erodibility.	Severe: moderately slow permeability.	Slight.
Erodibility on slopes; subject to piping in places.	Low to moderate seepage; can be used for dugouts in places.	Good to poor stability; erodibility on slopes; subject to piping in places; close control required in places.	Fair to good internal and surface drainage; subject to overflow in places.	High available water capacity; erodibility of steep slopes; protection from overflow needed in places.	(3/)----------	Moderate erodibility; erodibility maintenance costly when flooded.	Moderate: moderate permeability. Severe: overflow.	Moderate to severe: moderate permeability.

Soil series and map symbols	Suitability--					Soil properties affecting--	
	As source of--		Of material for--			Highway location	Foundations 1/
	Topsoil	Sand	Road subgrade: Paved	Road subgrade: Gravel	Road fill		
Hord: Hd, HdA, HdB, 2Hd, 2HdA.	Good	Poor to fair for fine sand in terrace phases only below a depth of 3 feet.	Fair to poor	Good to fair	Good to fair	Very high to high susceptibility to frost action; erodibility of slopes.	Good to poor bearing capacity; moderate piping hazard.
Ho	Good to fair	(2/)	Fair to poor	Fair to good	Fair to good	Moderate to high susceptibility to frost action; erodibility of slopes.	Good to poor bearing capacity.
Inavale: Iz, 2Iz	Fair to poor	Fair for fine sand below a depth of 3 feet.	Good to poor	Poor to good	Good to fair	Moderate to high susceptibility to frost action; high water table; occasional flooding; minimum fill needed in places; erodibility of slopes.	Generally good bearing capacity if confined; wet in places.
Lamo: Lb	Good to fair	(2/)	Poor	Good	Poor to fair	High to very high susceptibility to frost action; high water table; 4 to 7 feet of fill needed in places.	Fair to poor bearing capacity; wet in places.
Leshara: Le	Good	Fair to fine sand below a depth of 4 feet.	Fair to poor	Fair to good	Good to fair	High to very high susceptibility to frost action; high water table, minimum fill required; erodibility of slopes; wet.	Fair to poor bearing capacity; wet.
Loess hills and bluffs: Lh.	Poor	(2/)	Fair to poor	Good to fair	Fair	High susceptibility to frost action; deep cuts and high fill needed; erodibility of slopes.	Fair to poor bearing capacity.
Loretto: LlB2, LNC2, LvA2, LvB2. (For Nora part of mapping unit LNC2, refer to Nora series in this table.)	Good to fair	(2/)	Good to poor	Poor to good	Fair	Moderate to high susceptibility to frost action; erodibility of slopes.	Fair to good bearing capacity.

See footnotes at end of table.

Soil properties affecting--Continued								
Dikes and levees	Low dams		Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Soil limitations for sewage disposal	
	Reservoir	Embankment					Septic tank and filter fields	Sewage lagoons
Erodibility on slopes; subject to piping in places.	Generally low seepage.	Fair stability; erodibility on slopes; close control needed in places; fair to good workability.	Fair to good internal drainage; good surface drainage.	High available water capacity; deep.	Moderate erodibility.	Erodible	Moderate: moderate permeability.	Moderate to severe: moderate permeability.
Erodibility of slopes by wind and water; flat slopes required in places.	Low to moderate seepage.	Good to fair stability; subject to piping; erodibility of slopes; close control needed; fair to good workability.	Generally good internal and surface drainage.	Moderate available water capacity; subject to soil blowing.	Subject to erodibility of slopes by soil blowing and water.	Erodible	Slight	Moderate to severe: moderately rapid permeability.
Erodibility of slopes; subject to piping.	Moderate to high seepage.	Fair to good stability; fair to good workability; erodibility of slopes; toe drains needed in places.	Fair to good internal drainage; high water table and occasional overflow in places; adequate outlets not available in places.	Low available water capacity; adequate drainage needed.	(3/)	(3/)	Severe: high water table; flooding.	Severe: rapid permeability.
Moderate erodibility of slopes; cracks when dry in places.	Generally very low seepage.	Good to poor stability; impervious; fair to poor workability; moderate to high compressibility; wet.	Moderately slow internal and surface drainage; adequate outlets for surface or covered drains not available in places.	High available water capacity; adequate drainage needed; slow intake rate.	(3/)	Erodibility of slopes; water-tolerant grasses needed in places.	Severe: moderately slow permeability; high water table.	Slight.
Erodibility of slopes; subject to piping in places.	Moderate seepage.	Good to fair stability; close control required; moderate compressibility.	Good to fair internal and surface drainage; high water table; adequate outlets not available in places.	High available water capacity; adequate drainage needed in wet years; drainage outlets not available in places.	(3/)	Erodibility of slopes; drainage or water-tolerant grasses needed in places.	Severe: high water table.	Moderate to severe: moderate permeability.
(3/)	Moderate seepage.	Fair to good stability; erodibility of slopes; subject to piping; close control required.	Surface drainage excessive.	(3/)	Erodibility of diversion slopes.	High erodibility; difficult to vegetate; maintenance may be costly.	Severe: very steep slopes.	Severe: very steep slopes.
Moderate erodibility; subject to piping in places.	Low seepage	Fair to good stability; close control needed in places; erodibility of slopes; toe drains required in places.	Generally well drained.	Moderate to high available water capacity; erodibility of steep slopes.	Moderate erodibility.	Moderate erodibility.	Slight	Severe: moderate permeability.

Soil series and map symbols	Suitability--					Soil properties affecting--	
	As source of--		Of material for--				
			Road subgrade				
	Topsoil	Sand	Paved	Gravel	Road fill	Highway location	Foundations [1]
Loup: Lm----------	Poor to good--	Fair to good for fine sand below a depth of 2 feet.	Fair to poor--	Fair to good--	Good to fair--	Moderate to high susceptibility to frost action; high water table; ponding; 4 to 7 feet of fill needed; wet; erodibility of slopes; slopes require protection.	Good bearing capacity if confined; wet.
Moody: MoA, MoA2, MoB2--	Good to fair--	(2/)----------	Poor----------	Good----------	Fair to poor--	High susceptibility to frost action; erodibility of slopes.	Fair to poor bearing capacity.
Nora: NCD, NMB2, NoC, NoC2. (For Crofton part of unit NCD, and for Moody part of unit NMB2, refer to Crofton and Moody series, respectively, in this table.)	Good to fair--	(2/)----------	Poor----------	Good----------	Fair to poor--	Moderate to high susceptibility to frost action; erodibility of slopes.	Fair to poor bearing capacity.
Thurman: ThA, ThB, ThC, 2ThA, 5ThA, TV 3/. (For Valentine part of mapping unit TV, refer to Valentine series in this table.)	Fair to poor--	Generally good for fine sand below a depth of 3 feet.	Good to poor--	Poor to good--	Good to fair--	Moderate to low susceptibility to frost action; high erodibility of slopes; loose sand hinders hauling in places.	Good to poor bearing capacity depending on density.
Valentine: VaC, Vb------	Poor----------	Good for fine sand below a depth of 2 feet.	Good to fair--	Poor to fair--	Good----------	High susceptibility to soil blowing; slopes need protection.	Good to poor bearing capacity depending on density.
Wann: Wm----------	Fair to good--	Fair for fine sand below a depth of 3 feet.	Fair to poor--	Good to fair--	Good to fair--	Moderate to low susceptibility to frost action; erodibility of slopes; high water table; 4 to 7 feet of fill needed.	Good bearing capacity if sand confined; wet.
Wet alluvial land: Wx---	Fair to poor--	(2/)----------	Fair to poor--	Good to fair--	Fair to poor--	Moderate to high susceptibility to frost action; high water table; 4 to 7 feet of fill needed.	Fair to poor bearing capacity; wet.

1/ Engineers and others should not apply specific values to interpretations of bearing capacity in this column.

2/ Sand is generally not available.

3/ Because of position or topography including slope, this practice or structure is generally not needed or practical.

Soil properties affecting--Continued								
Dikes and levees	Low dams		Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Soil limitations for sewage disposal	
	Reservoir	Embankment					Septic tank and filter fields	Sewage lagoons
Erodibility on slopes; slopes require protection; severe piping hazard.	High seepage; can be used for dugouts in places.	Fair to good stability; pervious; toe drainage required in places; wet.	Poorly drained; high water table beneficial to grasses; drainage outlets not available in places.	(3/)----------	(3/)----------	(3/)----------	Severe: high water table.	Severe: rapid permeability.
(3/)----------	Generally low seepage.	Poor to good stability; moderate to high compressibility; impervious; good to poor workability.	Generally well drained.	High available water capacity; erodibility of steep slopes; deep.	Moderate erodibility	Moderate to high erodibility	Severe: moderately slow permeability.	Slight: moderately slow permeability.
(3/)----------	Low to moderate seepage.	Fair to good stability; impervious; fair to good workability; toe drains generally required.	Well drained----	High available water capacity; erodibility of steep slopes; deep.	High erodibility; construction and maintenance may be costly.	High erodibility; maintenance may be costly.	Moderate: moderate permeability.	Moderate to severe: moderate permeability; moderate slopes.
Erodibility of slopes; subject to piping and to "sand boils" in places.	Moderate to high seepage.	Fair to good stability; erodibility of slopes; fair to good workability; toe drains required in places.	Somewhat excessively drained.	Low available water capacity; rapid intake rate; thin; droughty; subject to severe erodibility from soil blowing.	Subject to erodibility by soil blowing and water; desirable layouts difficult; maintenance may be costly.	Droughty; subject to erodibility by soil blowing and water; maintenance may be extremely costly.	Slight---------	Severe: rapid permeability.
(3/)----------	High seepage--	Fair to good stability; pervious; slope protection required; good workability; low compressibility; loose sand hinders loading in places.	Excessively drained.	Low available water capacity; rapid intake rate; erodibility on steep slopes; severe erodibility from soil blowing.	(3/)----------	(3/)----------	Moderate to severe: slopes.	Severe: rapid permeability; slopes.
Erodibility of slopes; subject to piping in places.	Moderate seepage.	Good to fair stability; close control needed; generally good workability; moderate to low compressibility; wet.	Seasonally high water table; moderate to rapid internal drainage; suitable outlets not available in places.	Moderate available water capacity; adequate drainage needed.	(3/)----------	(3/)----------	Severe: high water table.	Severe: moderately rapid permeability.
Erodibility of slopes.	Low to moderate seepage; can be used for dugouts in places.	Poor to good stability; leveling required in places; impervious; fair workability.	Poor internal and surface drainage; high water table; ponded in places; adequate outlets not available in places.	(3/)----------	(3/)----------	(3/)----------	Severe: high water table.	Severe: moderate permeability; low position.

4/ Interpretations shown are for Ortello soils. For interpretations of Hord soils see Hord series.

5/ Interpretations shown are for Thurman soils with sand substratum. Interpretations for silty substratum phase requires onsite evaluation.

Topsoil is fertile soil material that ordinarily is rich in organic matter. It is used to topdress roadbanks, gardens, and lawns. The soils in table 7 are rated good, fair, poor, and very poor as a source of topsoil. Soils rated poor or fair to poor generally are low in content of organic matter or natural fertility, or they have a surface layer that is sticky and is difficult to work.

Sand and gravel generally are not available. The soils given ratings that indicate a possible source of sand may require detailed exploration to find sand and to determine its quantity and if the sand is of the gradation needed.

The soils are rated as subgrade material for bituminous or concrete paved roads and for gravel roads. Properly confined sand is the best subgrade for paved roads. The soil material is good if the AASHO classification is A-1 or A-3, good to fair if the classification is A-2, fair to poor if it is A-4, and poor if it is A-6 or A-7.

The ratings of the soils as subgrade for gravel roads are for that part of the subgrade that receives the gravel surfacing. Sand is not cohesive and does not provide a stable surface. The soil material is poor if classified A-1 or A-3, poor to fair if classified A-2, good to fair if it is A-4, and good if it is A-6 or A-7.

The ratings for road fill are based on about the same criteria as the ratings for subgrade under bituminous or concrete pavement. Some ratings for paved and gravel roads and for road fill are given as ranges because the soil in the profile varies.

Susceptibility to frost action is one of the factors that affects highway location. Frost action is a common but not a major problem in the county. The interpretations were made on the basis of the texture of the surface soil and subsoil. Clays and silts are susceptible to frost action if the underlying soil layers are pervious enough for water to rise and form ice lenses. In rating fine-grained soils that have a surface layer classified as ML, CL, or CH, the amount of clay material in the subsoil was considered. For example, if the surface layer is classified ML and the subsoil is less than 40 percent clay, the soil is rated very high. Uniform fine sands that have a surface layer classified as SM and that are less than 35 percent fines are rated low to none.

Soil properties that affect foundations are bearing capacity and susceptibility to liquefaction. The material evaluated is that part of the profile below a depth of 3 feet. Engineers should not apply numerical values to the interpretations of bearing capacity. All soils that have a high water table should be thoroughly investigated before structures of any kind are started. Draining water from the foundations may be needed.

The information given for dikes and levees applies only to the upper 18 inches of the soil. If large dikes or levees are planned, a detailed onsite investigation is needed.

Most reservoirs above small earth dams in this county lose water through seepage. The seepage is low to moderate on loessial soils and severe on soils underlain with sand. Sealing is needed in places to reduce the loss.

In compacted embankments, the soils are good to poor in stability. Workability is generally fair to good except for the more plastic clays. Toe drains may be needed.

Some of the soils have poor natural drainage because of a seasonally high water table, slow permeability, or both. Many of these soils also are subject to flooding, and others are nearly level and have slow runoff. Permeability, relief, height of the water table, and availability of outlets determine the kind of drainage that can be used effectively. These features are named for the soils to which they apply in table 6.

The main soil properties that affect irrigation are available water capacity and intake rate of water. In table 6 the interpretations for available water capacity in the irrigation column are for the top 5 feet of soil. The available water capacity is high if the soil holds more than 9 inches of water in the top 5 feet; moderate, if the soil holds 6 to 9 inches; and low if the soil holds 3 to 6 inches. The intake rate of water is given only if the rate is rapid or slow. The intake rate is that amount of water that enters the soil, under sprinkler or border irrigation, when the soil has an alfalfa or grass cover. The rate is expressed in inches per hour. A slow intake rate is less than 1/2 inch per hour, and a rapid one is 2 inches or more per hour.

Irrigation hazards related to slope are not listed for all soils. The Irrigation Guide for Central and Eastern Nebraska (7) contains information on the suitability of the soils for irrigation.

Level terraces are commonly used in this county to conserve soil and water. Diversion terraces are used in some places to protect lower lying areas, especially those downslope from grassland. Terrace slopes are erodible, but in most places the cost of maintenance is not high. Terraces built on the steep Crofton and Nora soils are an exception. The use of terraces is limited in some places by hummocky slopes.

Waterways are commonly used in the county. The ratings are based on construction hazards and the hazard of erosion after construction but before vegetation is established. The semihumid climate is a help in establishing vegetation.

The degree and kinds of limitations for sewage disposal systems are rated in table 6. Residences outside the areas served by public sewer systems normally use a septic tank and filter field, and developers of small housing areas prefer to use the sewer lagoon. Therefore, the limitations of soils for both methods of sewage disposal are given. The limitations are rated slight, moderate, and severe. If rated as moderate or severe, the limiting features are given. It should be pointed out that the ability of a soil to transmit water during a short period is not necessarily a measure of its ability to absorb sewage effluent over a long period. Before installing a septic tank and filter field,

percolation tests should be made at the site and a study made of existing installations on similar soils. Also consideration should be given to the proximity of wells and possible contamination of them.

The suitability of the soils for winter grading is not rated in table 6. Whether or not a soil can be graded in winter depends on the moisture content of the soil and on temperature, both of which vary from year to year. Soils that have a relatively high content of silt are predominant in the county. Consequently, few of the soils that receive moisture in the fall are adaptable to winter grading. Some soils on the bottom lands have a high water table or are subject to occasional flooding and generally cannot be graded in winter.

Many of the soils are susceptible to moderate or severe soil blowing. The hazard is of greatest concern in spring and fall and during construction, particularly if the cover of vegetation is sparse or lacking. The hazard of soil blowing is severe on the Elsmere, Ortello, Thurman, and Valentine soils.

FORMATION AND CLASSIFICATION OF THE SOILS

This section contains a discussion of the soil-forming factors and an explanation of the current system of classifying soils in categories above the series level.

Factors of Soil Formation

Soil is formed by weathering and other processes that act upon parent material. The characteristics of the soil at any given point depend on the parent material from which the soil formed; the climate under which the soil material has existed; the plants and animals in and on the soil; the relief, or lay of the land; and the length of time the factors of soil formation have acted on the soil material.

Climate and plants and animals are the active forces of soil formation. They act on the parent material accumulated through the weathering of rocks and slowly change it into soil. All five factors come into play in the formation of every soil. The relative importance of each differs from place to place; sometimes one is more important and sometimes another. In extreme cases one factor may dominate in the formation of a soil and fix most of its properties. In general, however, it is the combined action of the five factors that determines the present character of each soil.

The factors of soil formation are closely interrelated in their effects on the soil, and few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil formation are not known.

Parent Material

Parent material is the disintegrated and partly weathered rock from which soil has formed. The soils of Boone County formed in four kinds of parent material. These are windblown silt (Peoria loess), eolian sand, alluvium, and colluvium. All of the materials were deposited in late geologic time, during the Pleistocene epoch (3).

Peoria loess mantles all except the northwestern part of the county and the stream valleys. Most of this loess was blown from the Sandhills of Nebraska, which cover the northwestern part of Boone County and extend many miles westward. Recent deposits of loess originated in areas near the Cedar River and Beaver Creek. The Peoria loess consists of pale-yellow or olive-brown, limy, silty material that ranges from a few feet to 70 feet in thickness. It is underlain by pinkish-buff to reddish-brown silty clay to sand of the Loveland loess formation. This formation crops out in small areas.

Eolian sand covers the northwestern part of the county and small areas along Beaver Creek and the Cedar River. It covers two townships and is the eastern extension of the Sandhills of Nebraska. The material was blown from the Valentine formation, from other formations of the Tertiary period, and from the Grand Island and Holdrege sand and gravel sheets. The sand consists of well-sorted, clean grains. It is mostly quartz, but some of it was derived from feldspar. The sand has been piled by wind into hummocks or dunes. Sandy basins and valleys and exposed ground water lakes and marshes also are characteristic of the areas. Little water runs off the surface of the sandhills. Beaver Creek and the Cedar River both originate in the sandhills.

Most of the high terraces from Albion southeastward to the Nance County line along Beaver Creek and along the Cedar River are covered with loess mixed with colluvium. The other terraces or benches are covered with alluvium mixed with loess and eolian sand; dark-colored buried soils are on these terraces.

Alluvium covers most bottom lands along the Cedar River, Beaver Creek, and other streams of the county. It is a heterogeneous mixture of sand, silt, and clay of Recent age. Fresh deposits of alluvium are laid down by local flooding after heavy rains.

Colluvium is not a major source of parent material in Boone County. It consists mainly of recent deep deposits of silty material laid down by creep, local erosion, and slides near the base of the slopes between uplands and terraces.

Climate

Climate influences the formation of soils through its influence on the rate of weathering and reworking of parent material by rainfall, temperature, and wind. Boone County has a continental climate marked

by wide seasonal variations in temperature and precipitation. The average annual precipitation is 26 inches. Most of the precipitation comes in spring and summer as thunderstorms. Winters are cold, and summers are hot. The average annual temperature is 48° F. On the average about 150 days are free of frost.

The temperature and rainfall in the county are sufficient for growth of medium to tall prairie grasses. Precipitation in the county is not great enough, however, to leach the soils deeply. Lime generally is leached to a depth between 1 1/2 to 4 feet, except in the sandy soils which lack lime.

Plants and Animals

Trees, grass, and other herbaceous plants, microorganisms, earthworms, small burrowing animals, and other plants and animals on and in the soil are all active in the soil-forming processes.

Grass has had more influence than other kinds of plants on the soils of Boone County. Short and tall grasses were the main native plants. The fibrous roots of the grasses penetrate deep into the soil. Plant nutrients, mainly calcium, are brought to the surface by the roots and are returned to the surface layer through their stems and leaves as organic matter. This process tends to keep the soil porous and granular.

Micro-organisms act upon the organic matter in the soil and decompose it to stable humus. From this humus plants obtain nutrients. Earthworms, fungi, and small burrowing animals affect the formation of soils by mixing the organic and mineral parts. They also deepen the zone of organic-matter accumulation.

Man also affects the formation of soils. He determines, by the kind of management he uses, whether the soil is conserved or is lost through erosion. Thus, man through the way he manages the land he cultivates, affects the direction and rate of soil formation in the future.

Relief

Relief affects the formation of soils through its affect on runoff and drainage. The degree of slope, shape of the surface, and permeability of the soil determine the rate of runoff, the internal drainage, and the moisture content of the soil.

On steep slopes where runoff is rapid, little water is retained in the soil. Little soil development therefore takes place because the surface soil is removed almost as fast as it is formed. In the sandhills, runoff is slight and permeability is rapid. Internal drainage is good, and all of the excess water is moved by subsurface flow to Beaver Creek.

The soils on the nearly level uplands, terraces, and bottom lands absorb more moisture and have better developed profiles than those on strong slopes. Also, soils on bottom lands are affected more by underground water and by the moisture they receive from higher areas than they are by relief.

Time

Time is needed for the active agents of soil development to form soils from parent material. Some soils form rapidly, and others form slowly. The length of time required for a particular soil to form depends on the other factors involved. In Boone County the soils range from immature, or young, soils that show little or no development to mature, or old, soils that have fairly thick profiles and definite horizons.

Most of the soils on the bottom lands lack well-developed horizons because new deposits of alluvium are laid down before soil development can take place. The soils on steep slopes have been in place long enough for horizons to form, but because of the slope, the soil material has been removed before well-expressed horizons could form. The sandy soils on uplands, on the other hand, have been in place only a short time and well-defined horizons have not had time to develop. All of these soils are immature, or young, soils.

The soils on terraces and on nearly level to moderately sloping uplands have been in place long enough to develop profiles that have well-defined horizons. These soils have a thick, dark-colored surface layer and a distinct subsoil. They are approaching equilibrium with their environment and are considered to be mature, or old, soils.

Classification of the Soils

Soils are classified so that we can assemble more easily their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. Through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (2) and later revised (5). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study. Therefore, readers interested in developments of the current system should search the latest literature available (4, 8). In table 7 the soil series of

TABLE 7.--CLASSIFICATION OF SOILS[1/]

Series	Family	Subgroup	Order
Belfore	Fine, montmorillonitic, mesic	Udic Argiustolls	Mollisols.
Cass	Coarse-loamy, mixed, mesic	Fluventic Haplustolls	Mollisols.
Crofton	Fine-silty, mixed, calcareous, mesic	Typic Ustorthents	Entisols.
Elsmere	Sandy, mixed, mesic	Aquic Haplustolls	Mollisols.
Fillmore	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Gannett	Coarse-loamy, mixed, noncalcareous, mesic.	Typic Haplaquolls	Mollisols.
Hall	Fine-silty, mixed, mesic	Pachic Argiustolls	Mollisols.
Hobbs	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Hord	Fine-silty, mixed, mesic	Pachic Haplustolls	Mollisols.
Inavale	Mixed, mesic	Typic Ustipsamments	Entisols.
Lamo	Fine-silty, mixed, calcareous, mesic	Cumulic Haplaquolls	Mollisols.
Leshara	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Loretto	Fine-loamy, mixed, mesic	Udic Haplustolls	Mollisols.
Loup	Sandy, mixed, mesic	Typic Haplaquolls	Mollisols.
Moody	Fine-silty, mixed, mesic	Udic Haplustolls	Mollisols.
Nora	Fine-silty, mixed, mesic	Udic Haplustolls	Mollisols.
Ortello	Coarse-loamy, mixed, mesic	Udic Haplustolls	Mollisols.
Thurman	Sandy, mixed, mesic	Udorthentic Haplustolls	Mollisols.
Valentine	Mixed, mesic	Typic Ustipsamments	Entisols.
Wann	Coarse-loamy, mixed, mesic	Aquic Fluventic Haplustolls	Mollisols.

[1/] Placement of some soil series in the current system of classification, particularly in series and families may change as more information becomes available.

Boone County are placed in some categories of the current system.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar origin are grouped together. The classes of the current system are briefly defined in the following paragraphs.

ORDERS. Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties that differentiate these soil orders are those that give broad climatic groupings of soils. Two exceptions, the Entisols and Histosols, occur in many different kinds of climate. The two soil orders in Boone County are Entisols and Mollisols.

Entisols are recent mineral soils that do not have natural genetic horizons or have only the beginnings of such horizons.

Mollisols formed under grass and have a thick surface layer darkened by organic matter.

SUBORDERS. Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes having the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation.

GREAT GROUPS. Suborders are separated into great groups on basis of uniformity in the kinds and sequence of major horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that contain a pan that interferes with the growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 7, because it is the last word in the name of the subgroup.

SUBGROUPS. Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the great group.

FAMILIES. Families are separated within a subgroup primarily on the basis of properties important

to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES. The series consists of a group of soils that formed from a particular kind of parent material and having genetic horizons that, except for texture of the surface soils, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, consistence, reaction, and mineralogical and chemical composition.

GENERAL NATURE OF THE COUNTY

This section gives information about the climate, and the physiography, relief, and drainage of Boone County. It also gives facts about water supply, and farming.

Climate [7/]

Boone County, far removed from large bodies of water, has a distinct continental climate. Rainfall is moderate, summers are fairly warm, and winters are cold. The weather varies widely from day to day and from season to season. Most of the precipitation is brought to the county from the Gulf of Mexico by southerly winds. The rapid changes in temperature are caused by the interchange of warm air from the south and southwest with cold air from the north and northwest. Tables 8 and 9 give temperature and precipitation data for the county, and table 10 gives probable dates of specified low temperatures in spring and fall.

More than three-fourths of the annual precipitation generally falls during the period of April to September, which is the growing season. Early in spring precipitation is slow and steady and is well distributed. As the season advances, much of the rain falls during erratic thundershowers. By the latter part of May nearly all of the precipitation comes in such storms. Thunderstorms in spring and early in summer are severe at times, and some of them are accompanied by heavy local downpours, hail, and damaging winds. Occasionally a tornado occurs. Rains are likely to be heavy in one area, though a nearby area receives little or no rainfall. Locally, drought is likely to occur when the time or distribution of showers is poor.

An inch of rain falls in half an hour on an average of once a year, and more than 2 inches falls in 1 hour about once in 5 years. The hailstorms that accompany some of the heavy downpours generally are local and last only a short time. Damage from hail is variable and occurs in scattered areas. Corn is the principal crop in Boone County, and hailstorms early in the growing season may strip the leaves from the corn. If the storm is followed by favorable weather conditions, the young corn plants recover well. Hail storms are less frequent after the middle of July, but those that occur cause more permanent damage to the corn. The second largest acreage is occupied by hay. Damage by hail to this crop varies, depending on the stage of the development.

Precipitation from thundershowers is highest late in May and early in June, when the probability of getting 1 inch or more of moisture in a week is 40 percent. As summer advances the amount of precipitation decreases and is lowest about the second or third week of July, generally when temperatures are high. The combination of low moisture and high temperatures damages corn, especially if it occurs at the tasselling and silking stage. The showers increase again in the latter part of July and reach a secondary peak early in August. They then slowly decrease and become lighter and farther apart as fall progresses.

Precipitation in winter generally comes as light snow (table 8). Strong northerly winds often accompany the snow, which is likely to accumulate into drifts before the wind subsides. The average annual snowfall is about 30 to 35 inches, but the amount of snow varies considerably from year to year. The amount of snow remaining on the ground also varies greatly from one year to another, though generally a partial cover of snow can be expected from December to the middle of March. Normally snow covers the ground to a depth of an inch or more for 49 days, but the winter of 1948-49 had 124 such days and the winter 1945-46 had only 20 such days.

Prevailing winds are from south-southeast to southwest from May through September and from the north to northwest the rest of the year. The average annual velocity is about 10 to 12 miles an hour. The highest averages, about 12 to 14 miles per hour, are in March, April, and May. July, August, and September have the least wind. The strongest winds are associated with thunderstorms and are of short duration. In winter the strongest winds occur with an outbreak of cold air following the passage of a deep low pressure system, and they may last for several days.

In the following list are monthly amounts of potential evapotranspiration, in inches, as computed by the Thornthwaite method from mean temperatures at Albion for the period 1937 through 1966. The mean temperature for December through February is below 32° F.

	Inches		Inches
March	0.13	August	5.49
April	1.63	September	3.43
May	3.37	October	1.90
June	5.06	November	.30
July	6.24		

7/ By RICHARD E. MYERS, State climatologist, National Weather Service, U.S. Department of Commerce.

TABLE 8.--TEMPERATURE AND PRECIPITATION

[All data at Albion; probabilities of temperature based on period 1900-66; probabilities of precipitation based on period 1895-1966; all other data based on period 1937-66]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with--		Average monthly total	One year in 10 will have--		Days with a snow cover of 1 inch or more	Average depth of snow on days with snow cover
			Maximum temperature equal to or higher than--	Minimum temperature equal to or lower than--		Equal to or less than--	Equal to or more than--		
	° F.	° F.	° F.	° F.	Inches	Inches	Inches	Number	Inches
January---	33.2	8.6	55	-14	0.60	0.10	1.65	14	5.6
February--	37.6	13.5	59	- 9	.86	.20	1.42	14	4.9
March-----	45.8	22.5	72	2	1.56	.32	2.50	8	5.9
April-----	61.6	36.2	81	22	2.47	.73	5.00	1	2.1
May-------	73.0	47.3	89	33	4.18	1.62	6.34	(1/)	2.0
June------	82.0	57.4	96	45	4.38	2.04	6.62	0	---
July------	89.5	62.6	102	51	3.16	.86	5.88	0	---
August----	87.8	60.8	100	48	3.50	.97	5.84	0	---
September-	78.3	50.6	95	35	2.28	.56	5.20	0	---
October---	69.3	38.4	85	23	1.12	.08	3.27	(1/)	1.5
November--	50.4	23.9	69	11	.61	(2/)	2.23	3	3.4
December--	38.9	14.6	57	-6	.67	.09	1.67	10	4.8
Year----	62.3	36.4	3/ 103	4/ -21	25.39	17.99	32.60	50	5.1

1/ Less than 0.5 day.

2/ Trace.

3/ Average annual highest maximum.

4/ Average annual lowest minimum.

TABLE 9.--TEMPERATURE AND PRECIPITATION EXTREMES

[All data at Albion from 1895-1966]

Month	Temperature				Precipitation			
	Highest	Year	Lowest	Year	Driest	Year	Wettest	Year
January----------	68	1920	-37	1912	(1/)	1942	2.69	1915
February---------	77	1946	-32	1905	(1/)	1922	2.73	1915
March------------	90	1943	-24	1962	0.20	1907	4.97	1927
April------------	100	1910	- 2	1936	(1/)	1928	8.27	1896
May-------------	105	1934	23	1961	.71	1934	8.89	1905
June------------	108	1946	33	1917	.85	1933	10.19	1929
July------------	115	1936	31	1895	0	1895	9.73	1958
August----------	112	1934	32	1915	.11	1941	12.60	1966
September-------	106	1931	20	1899	.18	1940	8.60	1965
October---------	97	1947	1	1925	0	1958	4.41	1920
November--------	84	1914	-18	1964	0	1939	3.18	1919
December--------	78	1939	-29	1919	0	1903	3.80	1913
Year------------	115	1936	-37	1912	12.63	1936	34.87	1920

1/ Trace.

2/ Also in earlier year or years.

TABLE 10.--PROBABILITIES OF LAST FREEZING TEMPERATURE IN SPRING AND FIRST IN FALL

[All data at Albion]

Probability	Dates for given probability and temperature				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10 later than-----	April 11-----	April 18-----	April 30-----	May 14-------	May 22.
2 years in 10 later than----	April 5------	April 13-----	April 24-----	May 9--------	May 16.
5 years in 10 later than----	March 26-----	April 2------	April 14-----	April 28-----	May 6.
Fall:					
1 year in 10 earlier than---	October 23---	October 15---	October 6----	September 24-	September 17.
2 years in 10 earlier than--	October 28---	October 20---	October 11---	September 30-	September 22.
5 years in 10 earlier than--	November 8---	October 30---	October 21---	October 10---	October 1.

Physiography, Relief, and Drainage

Boone County is about 85 percent uplands, made up of the Loess Hills and of the Sandhills, and about 15 percent bottom lands, along the Cedar River, Beaver Creek, and smaller streams. Relief is nearly level to steep, but in most places it is moderately sloping. The uplands are cut by many areas of nearly level alluvial land. The elevation ranges from 1,640 feet along Beaver Creek in the southeastern part of the county to 2,100 feet near Akron.

The county is drained mainly by the Cedar River, which crosses the southwestern part of the county in a northeast to southeast direction, and by Beaver Creek, which flows diagonally across the county from the northwestern to the southeastern corner. Plum Creek, Timber Creek, and Shell Creek are among other smaller main drainageways. Nearly all of the county drains to the southeast, except for a few square miles along the northern boundary that drains north into the Elkhorn River.

Most of Boone County is well drained. In the Sandhills little water runs off, and surplus water seeps through the porous sand and reaches Beaver Creek through underground channels. Because of frequent overflow and underground seepage, most soils on low bottom lands of the Cedar River and Beaver Creek are poorly drained. The soils in some depressions on uplands and terraces are poorly drained because of their heavy subsoil and because of overflow.

Water Supply

Water is an important natural resource in the county. The water is of excellent quality, and wells to provide water for livestock are readily obtained in all parts of the county. In most of the county, the water supply is sufficient for irrigation. The wells in the silty uplands range from 100 to 200 feet in depth, and the water is obtained from the sand formation that underlies the mantle of loess. In the Sandhills wells range from 50 to 80 feet in depth. Artesian wells that average 30 feet in depth, are plentiful in the Beaver Creek Valley and throughout the Sandhills. The wells throughout the bottom lands and terraces range from 30 to 100 feet in depth.

Farming

Farming has always been important in Boone County. Wheat, corn, and other vegetables were grown by the early settlers, though a few cattle were raised. As transportation facilities improved and the Sandhills became settled, farmers started raising and feeding more livestock.

In 1945, according to the Nebraska Agricultural Statistics, 1,571 farms were in the county, and the average size of the farms was about 278 acres. In 1966, 1,080 farms were in the county, and the average size of the farms was about 405 acres.

According to the Nebraska Agricultural Statistics, 29,400 acres of land in Boone County was irrigated in 1967. The main source of water for irrigation is supplied by 318 wells. Some water for irrigation, however, is obtained by pumping from Beaver Creek and the Cedar River. The main irrigated crops are corn, sorghum, and alfalfa.

In 1964, according to the U.S. Census of Agriculture corn was grown on 100,990 acres; sorghum, on 33,400 acres; and alfalfa, on 32,680 acres. Corn is the most extensive cultivated crop in the county. Alfalfa is grown on most farms, and especially where livestock is fed. Sorghum and wheat are important cash crops. Oats is grown mainly for feed. Other crops are soybeans, barley, vetch, and rye.

The Nebraska Agricultural Statistics for 1966 show that 81,000 cattle were on the farms of Boone County, and 5,800 of these were milk cows. In the same year 59,700 hogs and 3,050 sheep were reported on the farms. Chickens are raised on many farms, and in addition horses are raised on some farms for riding and show purposes.

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GLOSSARY

Alkali soil. Generally, a strongly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Blowout. An excavation produced by wind action in loose soil, generally sand.

Bottom land. The normal flood plain of a stream, part of which may be flooded frequently.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are--

Loose.--Noncoherent when dry or moist; does not hold together in a mass.

Friable.--When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.--When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.--When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.--When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.--When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

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Soft.--When dry, breaks into powder or individual grains under very slight pressure.

Cemented.--Hard and brittle; little affected by moistening.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.--The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.--The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.--The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.--The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.--Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by height of the water table, either permanent or perched. Relative terms for expressing internal drainage are none, very slow, slow, medium, rapid, and very rapid.

Leached soil. A soil from which most of the soluble material has been removed from the entire profile or has been removed from one part of the profile and has accumulated in another part.

Lime. Chemically, lime is calcium oxide (CaO), but its meaning has been extended to include all limestone-derived materials applied to neutralize acid soils. Agricultural lime can be obtained as ground limestone, hydrated lime, or burned lime, with or without magnesium minerals. Basic slag, oystershells, and marl also contain calcium. Lime as used in this survey means carbonate salts naturally present in the soils.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance--few, common, and many; size--fine, medium, and coarse; and contrast--faint, distinct, and prominent. The size measurements are these: fine, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; medium, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and coarse, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables--hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Runoff. The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; or contains harmful salts and has a strongly alkaline reaction; or contains harmful salts and exchangeable sodium, and is strongly alkaline in reaction. The salts, exchangeable sodium, and alkaline reaction occur in the soil in such location that growth of most crop plants is less than normal.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slickspots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are--platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are (1) single grain (each grain by itself, as in dune sand) or (2) massive (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically the part of the soil below the solum.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (engineering). An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit, a range site, or a windbreak suitability group, read the introduction to the section it is in for general information about its management. For facts about wildlife and recreation, turn to the section beginning on p. 48. Other information is given in tables as follows:

Acreage and extent, table 1, page 9.
Predicted yields, table 2, page 42.
Engineering uses of the soils, tables 4, 5, and 6, pages 52 through 69.

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Page	Capability unit: Irrigated Symbol	Page	Range site: Name	Page	Windbreak suitability group: Name	Page
Be	Belfore silt loam, 0 to 1 percent slopes	10	I-1	33	I-1	39	Silty	46	Silty to Clayey	47
B	Blown-out land	10	VIIe-5	38	------	--	Sands	45	Very Sandy	48
CfD2	Crofton silt loam, 7 to 17 percent slopes, eroded	11	IVe-8	36	------	--	Limy Upland	46	Silty to Clayey	47
CfE2	Crofton silt loam, 17 to 30 percent slopes, eroded	11	VIe-8	37	------	--	Limy Upland	46	Silty to Clayey	47
CNC2	Crofton-Nora silt loams, 7 to 12 percent slopes, eroded	12	IIIe-8	35	IVe-1	41	Limy Upland and Silty	46	Silty to Clayey	47
CND2	Crofton-Nora silt loams, 12 to 17 percent slopes, eroded	12	IVe-8	36	------	--	Limy Upland and Silty	46	Silty to Clayey	47
CNE	Crofton-Nora silt loams, 17 to 30 percent slopes	12	VIe-9	37	------	--	Limy Upland and Silty	46	Silty to Clayey	47
Cz	Cass soils	11	I-1	33	I-1	39	Sandy Lowland	45	Silty to Clayey	47
Ea	Elsmere loamy fine sand	13	IIIw-5	35	------	--	Subirrigated	44	Moderately Wet	48
Eb	Elsmere fine sand	13	VIw-5	37	------	--	Subirrigated	44	Moderately Wet	48
Fm	Fillmore silt loam	14	IIIw-2	35	IIs-2	40	Clayey Overflow	45	Wet	48
Ga	Gannett fine sandy loam	15	Vw-1	36	------	--	Wetland	44	Wet	48
Ha	Hall silt loam, 0 to 1 percent slopes	15	I-1	33	I-1	39	Silty Lowland	45	Silty to Clayey	47
HaA	Hall silt loam, 1 to 3 percent slopes	16	IIe-1	34	IIe-1	39	Silty Lowland	45	Silty to Clayey	47
Hb	Hobbs silt loam, 0 to 1 percent slopes	17	I-1	33	I-1	39	Silty Lowland	45	Silty to Clayey	47
2Hb	Hobbs silt loam, 0 to 1 percent slopes, occasionally flooded	17	IIw-3	34	I-1	39	Silty Overflow	44	Moderately Wet	48
Hd	Hord silt loam, 0 to 1 percent slopes	18	I-1	33	I-1	39	Silty	46	Silty to Clayey	47
HdA	Hord silt loam, 1 to 3 percent slopes	18	IIe-1	34	IIe-1	39	Silty	46	Silty to Clayey	47
HdB	Hord silt loam, 3 to 7 percent slopes	18	IIe-1	34	IIIe-1	40	Silty	46	Silty to Clayey	47
2Hd	Hord silt loam, terrace, 0 to 1 percent slopes	18	I-1	33	I-1	39	Silty Lowland	45	Silty to Clayey	47
2HdA	Hord silt loam, terrace, 1 to 3 percent slopes	19	IIe-1	34	IIe-1	39	Silty Lowland	45	Silty to Clayey	47
HO	Hord and Ortello fine sandy loams, 1 to 3 percent slopes	19	IIe-3	34	IIe-3	39	Sandy	45	Sandy	47
HSzA	Hall-Slickspots complex, 1 to 3 percent slopes	16	IIIs-1	36	IIs-1	40	Silty Lowland	45	Silty to Clayey	47
Iz	Inavale soils	19	IIIe-3	35	------	--	Sands	45	Sandy	47
2Iz	Inavale soils, wet	20	IIIw-6	36	------	--	Subirrigated	44	Moderately Wet	48
Lb	Lamo silty clay loam	20	IIw-4	34	IIw-4	40	Subirrigated	44	Moderately Wet	48
Le	Leshara silt loam	21	IIw-4	34	IIw-4	40	Subirrigated	44	Moderately Wet	48
Lh	Loess hills and bluffs	22	VIIe-1	37	------	--	Thin Loess	46	Silty to Clayey	47

U. S. GOVERNMENT PRINTING OFFICE : 1971 O - 421-335

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Page	Capability unit: Irrigated Symbol	Page	Range site: Name	Page	Windbreak suitability group: Name	Page
L1B2	Loretto loam, 3 to 7 percent slopes, eroded	23	IIe-1	34	IIIe-1	40	Silty	46	Silty to Clayey	47
Lm	Loup loam	24	Vw-1	36	------	--	Wetland	44	Wet	48
LNC2	Loretto-Nora fine sandy loams, 7 to 12 percent slopes, eroded	23	IIIe-3	35	------	--	Sandy	45	Sandy	47
LvA2	Loretto fine sandy loam, 0 to 3 percent slopes, eroded	22	IIe-3	34	IIe-3	39	Sandy	45	Sandy	47
LvB2	Loretto fine sandy loam, 3 to 7 percent slopes, eroded	23	IIe-3	34	IIIe-3	41	Sandy	45	Sandy	47
M	Marsh	24	VIIIw-3	38	------	--	--------	--	Nonplantable	48
MoA	Moody silty clay loam, 1 to 3 percent slopes	24	IIe-1	34	IIe-1	39	Silty	46	Silty to Clayey	47
MoA2	Moody silty clay loam, 1 to 3 percent slopes, eroded	25	IIe-1	34	IIe-1	39	Silty	46	Silty to Clayey	47
MoB2	Moody silty clay loam, 3 to 7 percent slopes, eroded	25	IIe-1	34	IIIe-1	40	Silty	46	Silty to Clayey	47
NCD	Nora-Crofton silt loams, 12 to 17 percent slopes	26	IVe-1	36	------	--	Silty and Limy Upland	46	Silty to Clayey	47
NMB2	Nora-Moody complex, 3 to 7 percent slopes, eroded	26	IIIe-8	35	IIIe-1	40	Silty	46	Silty to Clayey	47
NoC	Nora silt loam, 7 to 12 percent slopes	26	IIIe-1	34	IVe-1	41	Silty	46	Silty to Clayey	47
NoC2	Nora silt loam, 7 to 12 percent slopes, eroded	26	IIIe-1	34	IVe-1	41	Silty	46	Silty to Clayey	47
Sx	Sandy alluvial land	27	VIw-1	37	------	--	Sandy Lowland	45	Very Sandy	48
Sy	Silty alluvial land	28	VIw-1	37	------	--	Silty Overflow	44	Moderately Wet	48
ThA	Thurman loamy fine sand, 0 to 3 percent slopes	28	IIIe-5	35	IVe-5	41	Sandy	45	Sandy	47
2ThA	Thurman loamy fine sand, silty substratum, 0 to 3 percent slopes	29	IIIe-5	35	IVe-5	41	Sandy	45	Sandy	47
5ThA	Thurman loamy fine sand, terrace, 0 to 3 percent slopes	29	IIIe-5	35	IVe-5	41	Sandy Lowland	45	Sandy	47
ThB	Thurman loamy fine sand, 3 to 7 percent slopes	28	IIIe-5	35	------	--	Sandy	45	Sandy	47
ThC	Thurman loamy fine sand, 7 to 12 percent slopes	29	VIe-5	37	------	--	Sands	45	Very Sandy	48
TV	Thurman-Valentine complex, 0 to 3 percent slopes	29	VIe-5	37	------	--	Sandy	45	Very Sandy	48
VaC	Valentine fine sand, rolling	30	VIe-5	37	------	--	Sands	45	Very Sandy	48
Vb	Valentine loamy fine sand, undulating	30	VIe-5	37	------	--	Sands	45	Very Sandy	48
Wm	Wann loam	31	IIw-4	34	IIw-4	40	Subirrigated	44	Moderately Wet	48
Wx	Wet alluvial land	31	Vw-1	36	------	--	Wetland	44	Wet	48

Accessibility Statement

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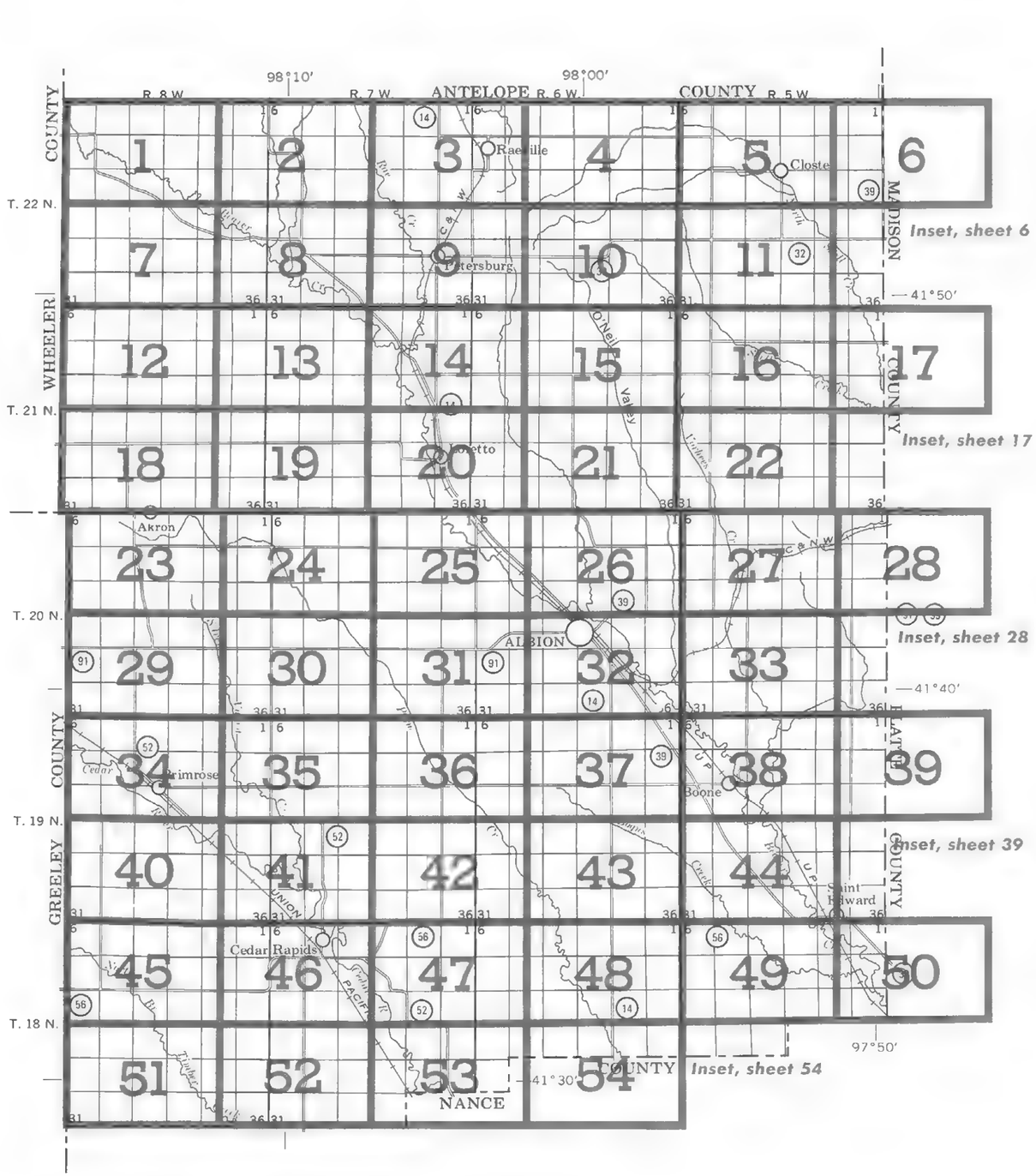


INDEX TO MAP SHEETS

BOONE COUNTY, NEBRASKA

Scale 1:253,440

1 0 1 2 3 4 Miles

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

BOONE COUNTY, NEBRASKA

UNIVERSITY OF NEBRASKA
CONSERVATION AND SURVEY DIVISION

SOIL LEGEND

Each soil symbol consists of letters or of letters and numbers; for example, Be, CfD2, CNE, or 2Hb. If slope is given in the soil name and is more than 1 percent, the last capital letter, A, B, C, D, or E, in a symbol shows the slope class. A final number, 2, indicates an eroded soil.

SYMBOL	NAME
B	Blown-out land
Be	Belfore silt loam, 0 to 1 percent slopes
CfD2	Crofton silt loam, 7 to 17 percent slopes, eroded
CfE2	Crofton silt loam, 17 to 30 percent slopes, eroded
CNC2	Crofton-Nora silt loams, 7 to 12 percent slopes, eroded
CND2	Crofton-Nora silt loams, 12 to 17 percent slopes, eroded
CNE	Crofton-Nora silt loams, 17 to 30 percent slopes
Cz	Cass soils
Eo	Elsmere loamy fine sand
Eb	Elsmere fine sand
Fm	Fillmore silt loam
Ga	Gannett fine sandy loam
Ha	Hall silt loam, 0 to 1 percent slopes
HaA	Hall silt loam, 1 to 3 percent slopes
Hb	Hobbs silt loam, 0 to 1 percent slopes
2Hb	Hobbs silt loam, 0 to 1 percent slopes, occasionally flooded
Hd	Hord silt loam, 0 to 1 percent slopes
HdA	Hord silt loam, 1 to 3 percent slopes
HdB	Hord silt loam, 3 to 7 percent slopes
2Hd	Hord silt loam, terrace, 0 to 1 percent slopes
2HdA	Hord silt loam, terrace, 1 to 3 percent slopes
HO	Hord and Ortello fine sandy loams, 1 to 3 percent slopes
HSzA	Hall-Slickspots complex, 1 to 3 percent slopes
Iz	Inavale soils
2Iz	Inavale soils, wet
Lb	Lamo silty clay loam
Le	Leshara silt loam
Lh	Loess hills and bluffs
LlB2	Loretto loam, 3 to 7 percent slopes, eroded
Lm	Loup loam
LNC2	Loretto-Nora fine sandy loams, 7 to 12 percent slopes, eroded
LvA2	Loretto fine sandy loam, 0 to 3 percent slopes, eroded
LvB2	Loretto fine sandy loam, 3 to 7 percent slopes, eroded
M	Marsh
MoA	Moody silty clay loam, 1 to 3 percent slopes
MoA2	Moody silty clay loam, 1 to 3 percent slopes, eroded
MoB2	Moody silty clay loam, 3 to 7 percent slopes, eroded
NCD	Nora-Crofton silt loams, 12 to 17 percent slopes
NMB2	Nora-Moody complex, 3 to 7 percent slopes, eroded
NoC	Nora silt loam, 7 to 12 percent slopes
NoC2	Nora silt loam, 7 to 12 percent slopes, eroded
Sx	Sandy alluvial land
Sy	Silty alluvial land
ThA	Thurman loamy fine sand, 0 to 3 percent slopes
2ThA	Thurman loamy fine sand, silty substratum, 0 to 3 percent slopes
5ThA	Thurman loamy fine sand, terrace, 0 to 3 percent slopes
ThB	Thurman loamy fine sand, 3 to 7 percent slopes
ThC	Thurman loamy fine sand, 7 to 12 percent slopes
TV	Thurman-Valentine complex, 0 to 3 percent slopes
VaC	Valentine fine sand, rolling
Vb	Valentine loamy fine sand, undulating
Wm	Wann loam
Wx	Wet alluvial land

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Tunnel

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

BOUNDARIES

- National or state
- County
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches (CANAL)

Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

Well, irrigation (o I.W.)

Well, water, artesian

RELIEF

Escarpments
- Bedrock
- Other

Prominent peak

Depressions, unclassified (Large, Small)

SOIL SURVEY DATA

Soil boundary and symbol (Dx)

Gravel

Stoniness
- Stony
- Very stony

Rock outcrops

Chert fragments

Clay spot

Sand spot

Gumbo or scabby spot

Made land

Severely eroded spot

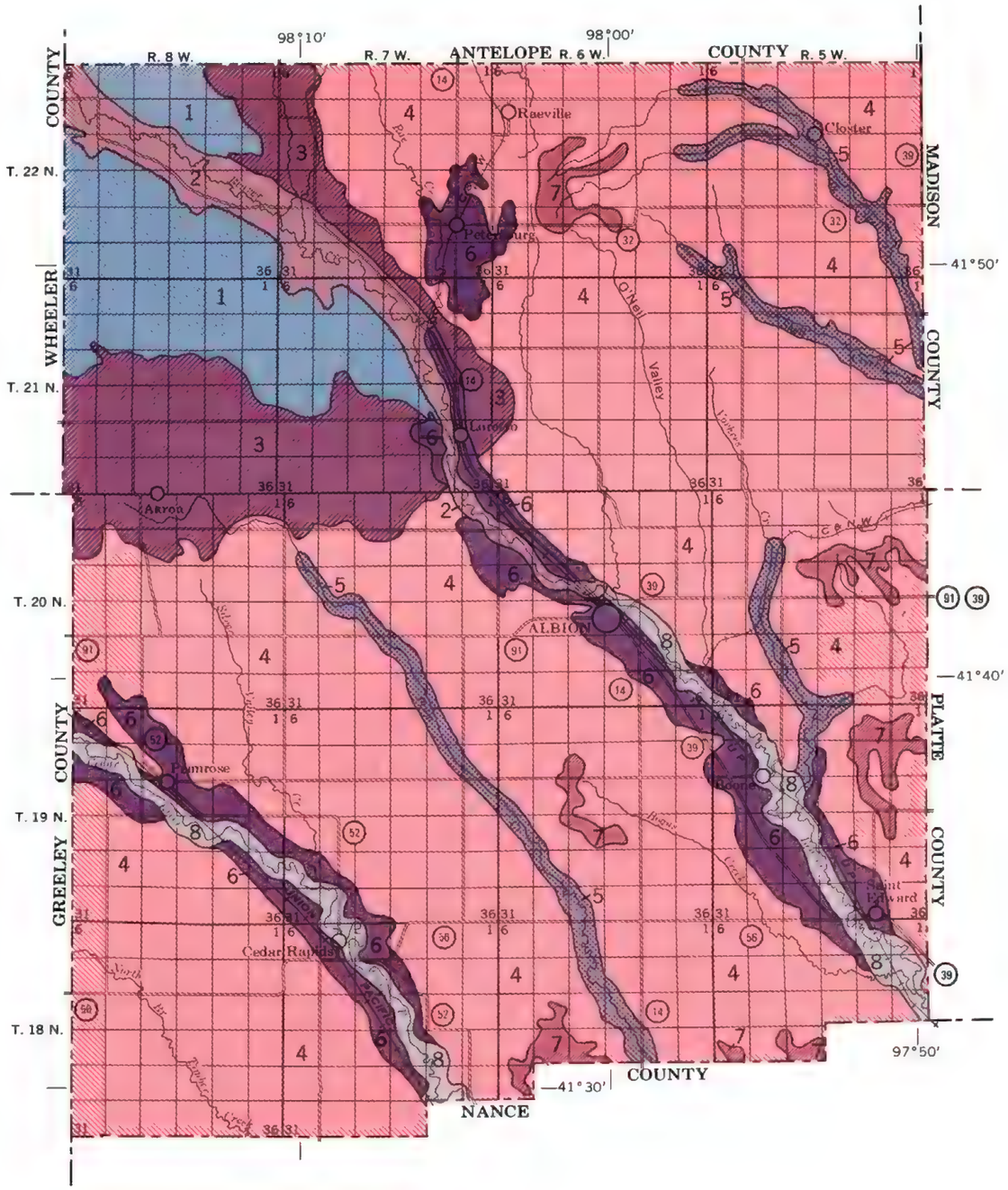
Blowout, wind erosion

Gully

Short steep slope

Alkali or saline spot

Loveland soil material



N

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

UNIVERSITY OF NEBRASKA,
CONSERVATION AND SURVEY DIVISION

GENERAL SOIL MAP

BOONE COUNTY, NEBRASKA

Scale 1:253,440

1 0 1 2 3 4 Miles

SOIL ASSOCIATIONS *

1. Valentine association: Excessively drained, gently sloping to strongly sloping soils that are sandy throughout; on uplands
2. Elsmere-Wann-Loup association: Somewhat poorly drained and poorly drained, nearly level to gently sloping, sandy and loamy soils on bottom lands and stream terraces
3. Thurman-Hord-Loretto association: Somewhat excessively drained and well drained, nearly level to rolling, sandy and silty soils on uplands
4. Nora-Crofton-Moody association: Well-drained to excessively drained, gently sloping to steep, silty soils on uplands
5. Hobbs association: Well-drained, nearly level, silty soils on bottom lands that are subject to occasional flooding
6. Hall-Hord association: Well-drained, nearly level to gently sloping, silty soils on stream terraces
7. Belfore-Moody association: Well-drained, nearly level and very gently sloping, silty soils on uplands
8. Leshara-Lamo-Wann association: Somewhat poorly drained, nearly level, silty and loamy soils on bottom lands

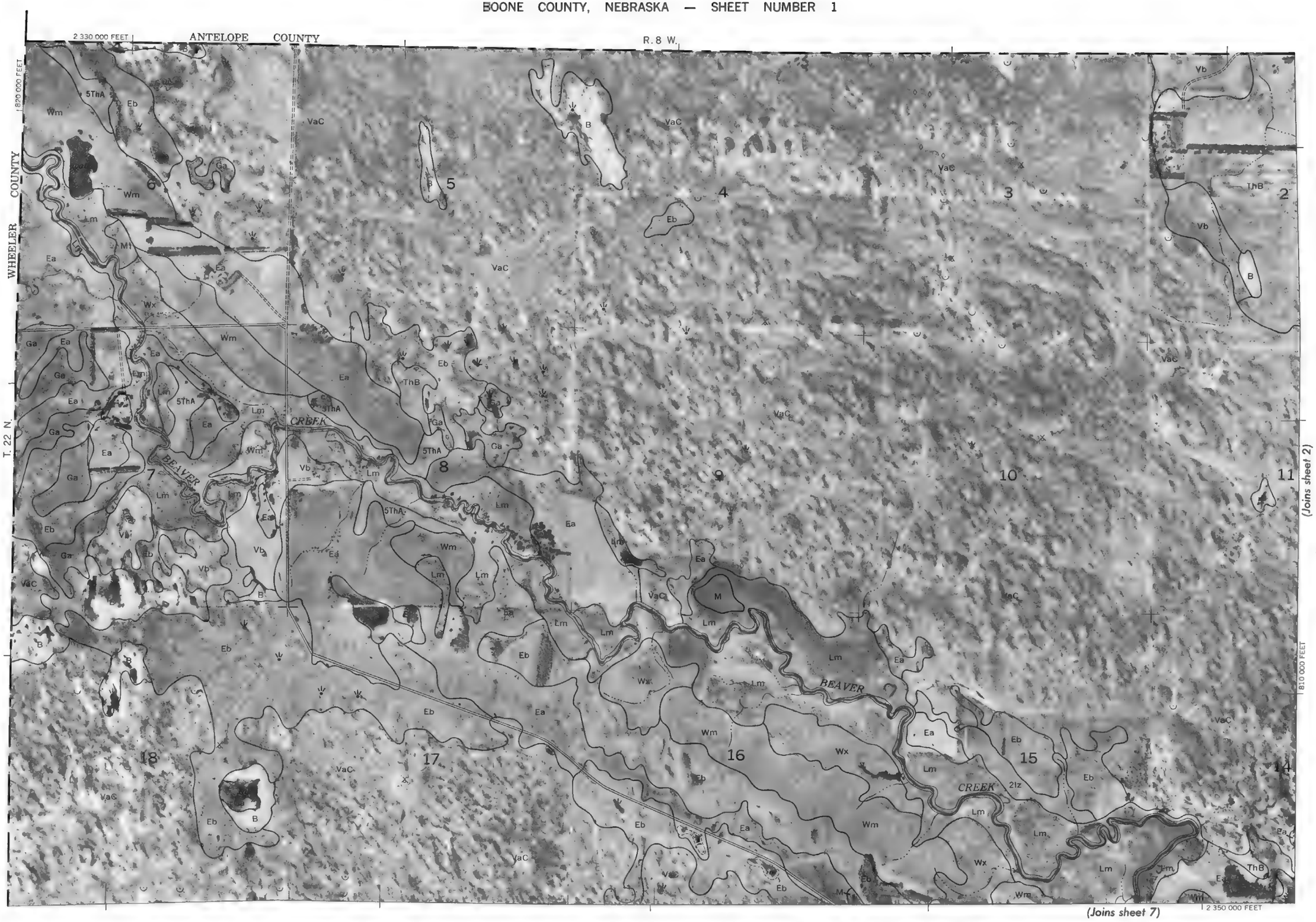
* Unless otherwise stated texture refers to surface layer.

March 1971

NOTE—

This map is intended for general planning. Each delineation may contain soils having ratings different from those shown on the map. Use detailed soil maps for operational planning.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 1



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 1

Photobase from 1963 aerial photographs.
5,000-foot grid ticks based on Nebraska plane coordinate system, south zone. 1927 North American datum.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 2

N

R. 8 W. | R. 7 W.

2 355 000 FEET

ANTELOPE COUNTY

820 000 FEET

T. 22 N.

810 000 FEET

2 375 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 8)

BOONE COUNTY, NEBRASKA NO. 2

Land division corners are approximately positioned on this map.

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Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 3

1 Mile
5 000 Feet
Scale 1:20 000

N

BOONE COUNTY, NEBRASKA — SHEET NUMBER 3

(3)

BOONE COUNTY, NEBRASKA — SHEET NUMBER 4

(4)

N

2 400 000 FEET

R. 6 W.

ANTELOPE COUNTY

820 000 FEET

T. 22 N.

1 Mile

5 000 Feet

Scale 1:20 000

(Joins sheet 3)

(Joins sheet 5)

(Joins sheet 10)

2 420 000 FEET

810 000 FEET

BOONE COUNTY, NEBRASKA NO. 4

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Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 5

2 425 000 FEET

ANTELOPE COUNTY

R. 5 W.

820 000 FEET

T. 22 N.

(Joins sheet 4)

North Branch Zion Church

ZION WEST CEMETERY

Closter

(Joins sheet 11)

2 445 000 FEET

810 000 FEET

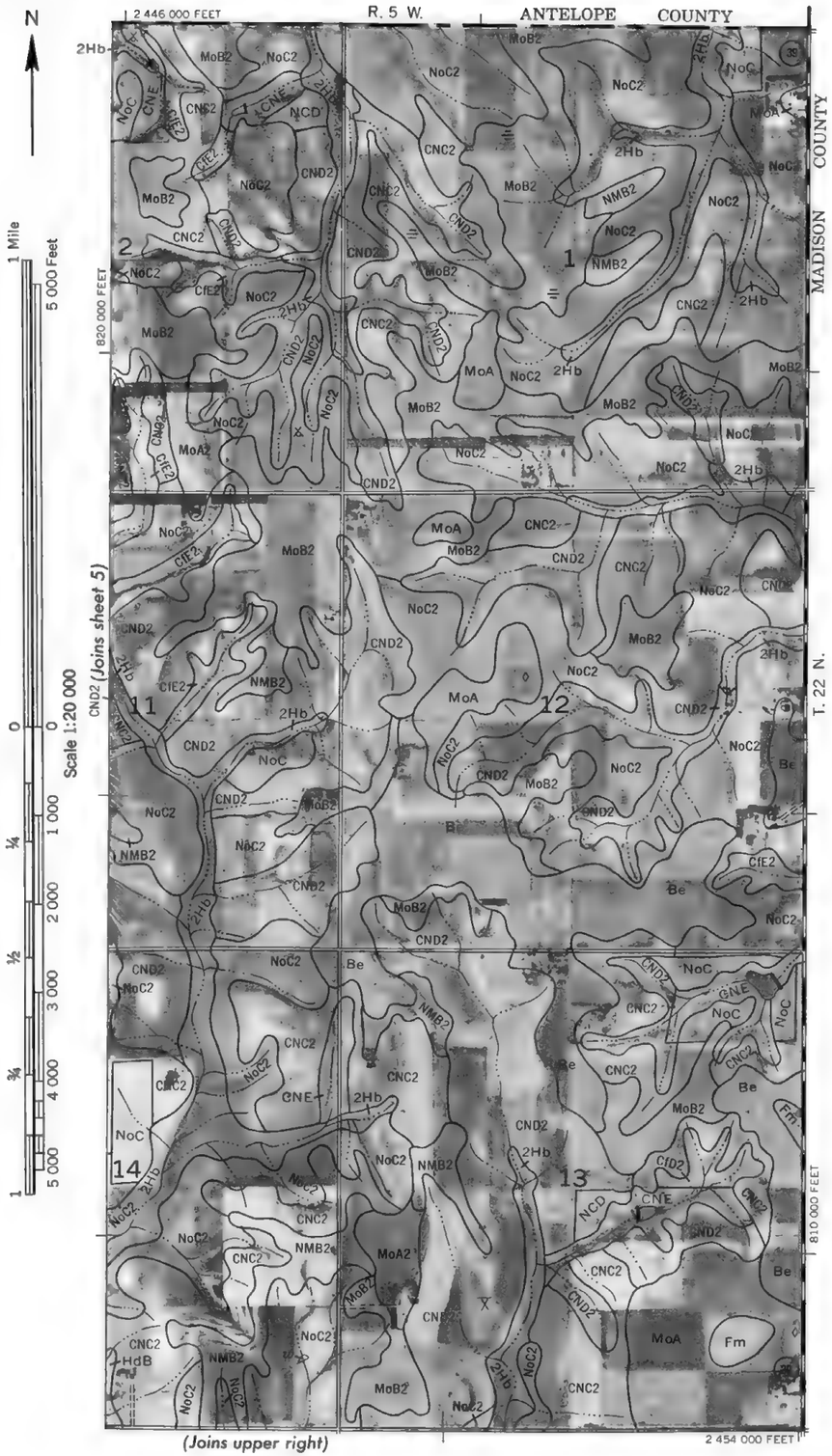
(Joins sheet 6)

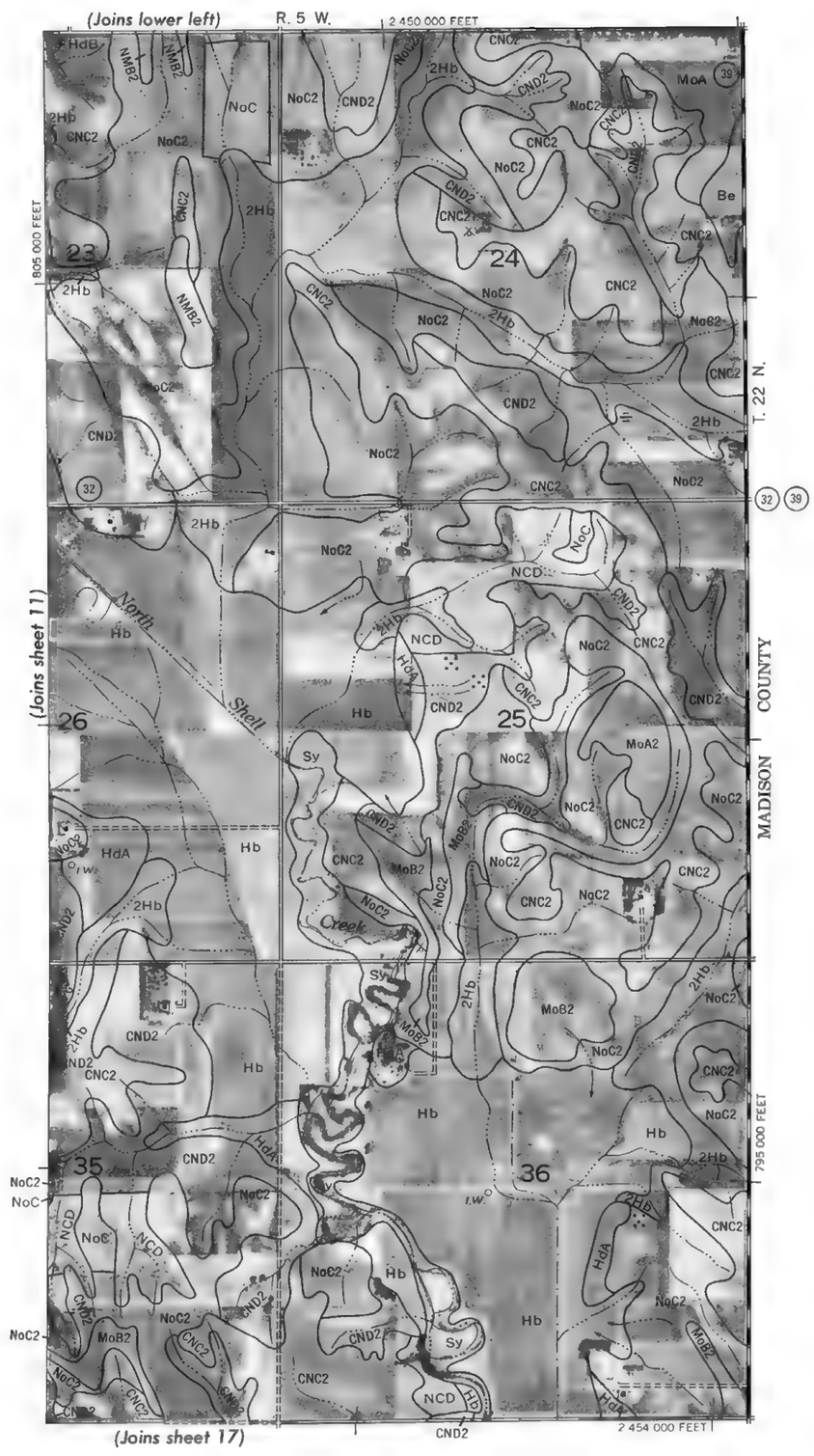
N

1 Mile

5 000 Feet

Scale 1:20 000





BOONE COUNTY, NEBRASKA NO. 6

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Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 7

(7)

N

(Joins sheet 1)

2 330 000 FEET

805 000 FEET

R. 8 W.

T. 22 N.

WHEELER COUNTY

BRAINARD CREEK

1 Mile

5 000 Feet

Scale 1:20 000

(Joins sheet 8)

1 795 000 FEET

(Joins sheet 12)

2 350 000 FEET

BOONE COUNTY, NEBRASKA — SHEET NUMBER 8

(8)

N

R.8 W. | R.7 W.

805 000 FEET

2 355 000 FEET

(Joins sheet 2)

(Joins sheet 7)

(Joins sheet 13)

(Joins sheet 9)

795 000 FEET

2 375 000 FEET

T. 22 N.

1 Mile

5 000 Feet

Scale 1:20 000

BOONE COUNTY, NEBRASKA NO. 8

Land division corners are approximately positioned on this map.

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BOONE COUNTY, NEBRASKA NO. 9

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Land division corners are approximately positioned on this map.

(10)

N

2 400 000 FEET

(Joins sheet 4)

R. 6 W.

805 000 FEET

T. 22 N.

795 000 FEET

2 420 000 FEET

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 15)

1 Mile

5 000 Feet

Scale 1:20 000

1 000 0 1 000 2 000 3 000 4 000 5 000

1/4 1/2 3/4 1

BOONE COUNTY, NEBRASKA NO. 10

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 11

(11)

N

R. 5 W.

2 425 000 FEET

805 000 FEET

T. 22 N.

(Joins sheet 5)

(Joins sheet 10)

(Joins sheet 6)

(Joins sheet 16)

2 445 000 FEET

795 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

BOONE COUNTY, NEBRASKA NO. 11

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.

(12)

N

2 330 000 FEET

(Joins sheet 7)

R. 8 W.

T. 21 N.

785 000 FEET

775 000 FEET

2 350 000 FEET

(Joins sheet 13)

(Joins sheet 18)

1 Mile

5 000 Feet

Scale 1:20 000

WHEELER COUNTY

Vb ThA ThB VaC B 2ThA LvA2 LvB2 ThC TV HO Ga int

1 2 3 4 5 6 7 8 9 10 11 14 15 16 17

BOONE COUNTY, NEBRASKA NO. 12

Land division corners are approximately positioned on this map.

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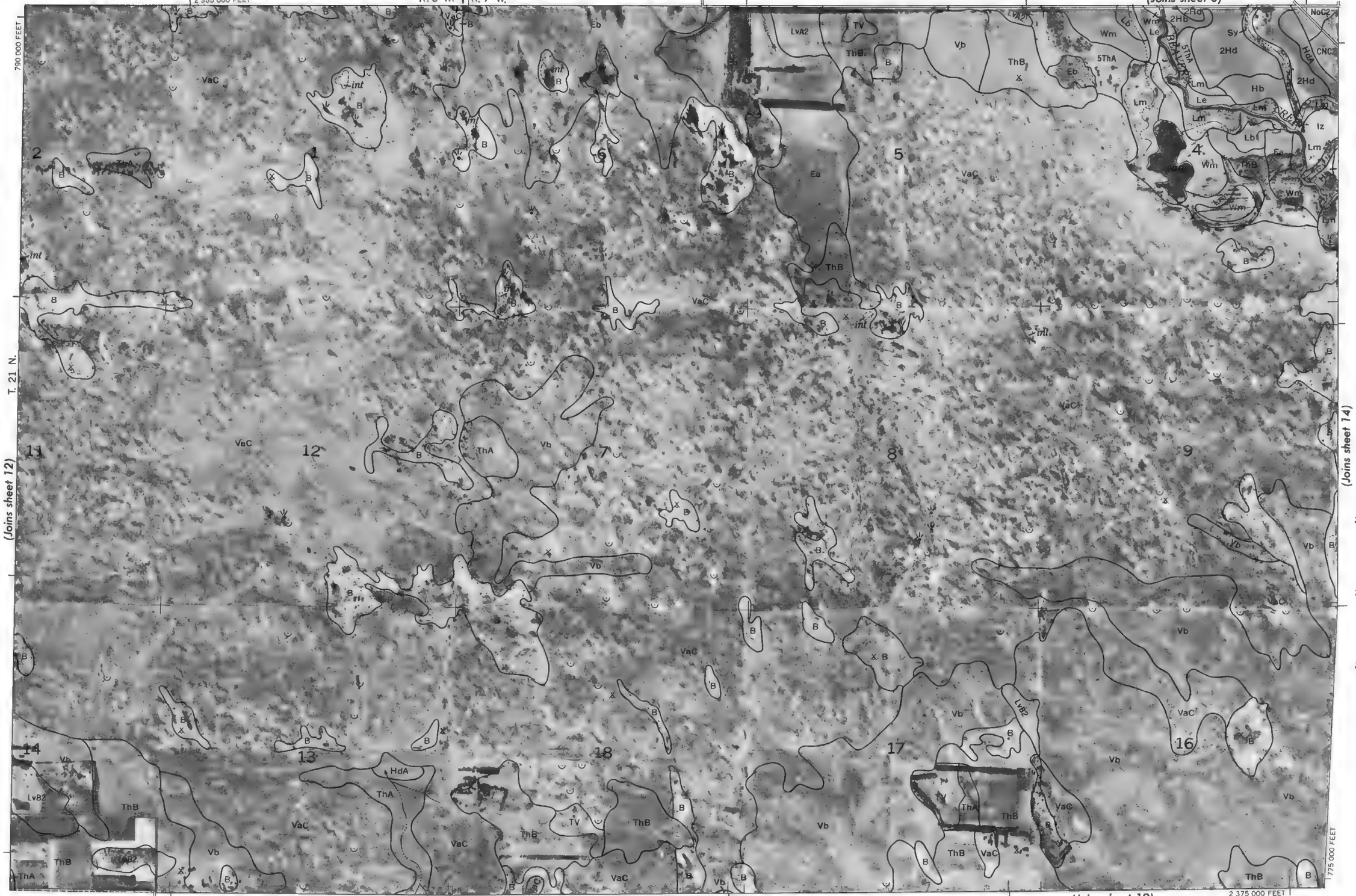
Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 13



BOONE COUNTY, NEBRASKA — SHEET NUMBER 14

(14)

N

(Joins sheet 9)

2 380 000 FEET

R. 7 W. | R. 6 W.

790 000 FEET

T. 21 N.

780 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

(Joins sheet 13)

(Joins sheet 15)

(Joins sheet 20)

2 395 000 FEET

BOONE COUNTY, NEBRASKA NO. 14

Land division corners are approximately positioned on this map.

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BOONE COUNTY, NEBRASKA — SHEET NUMBER 15

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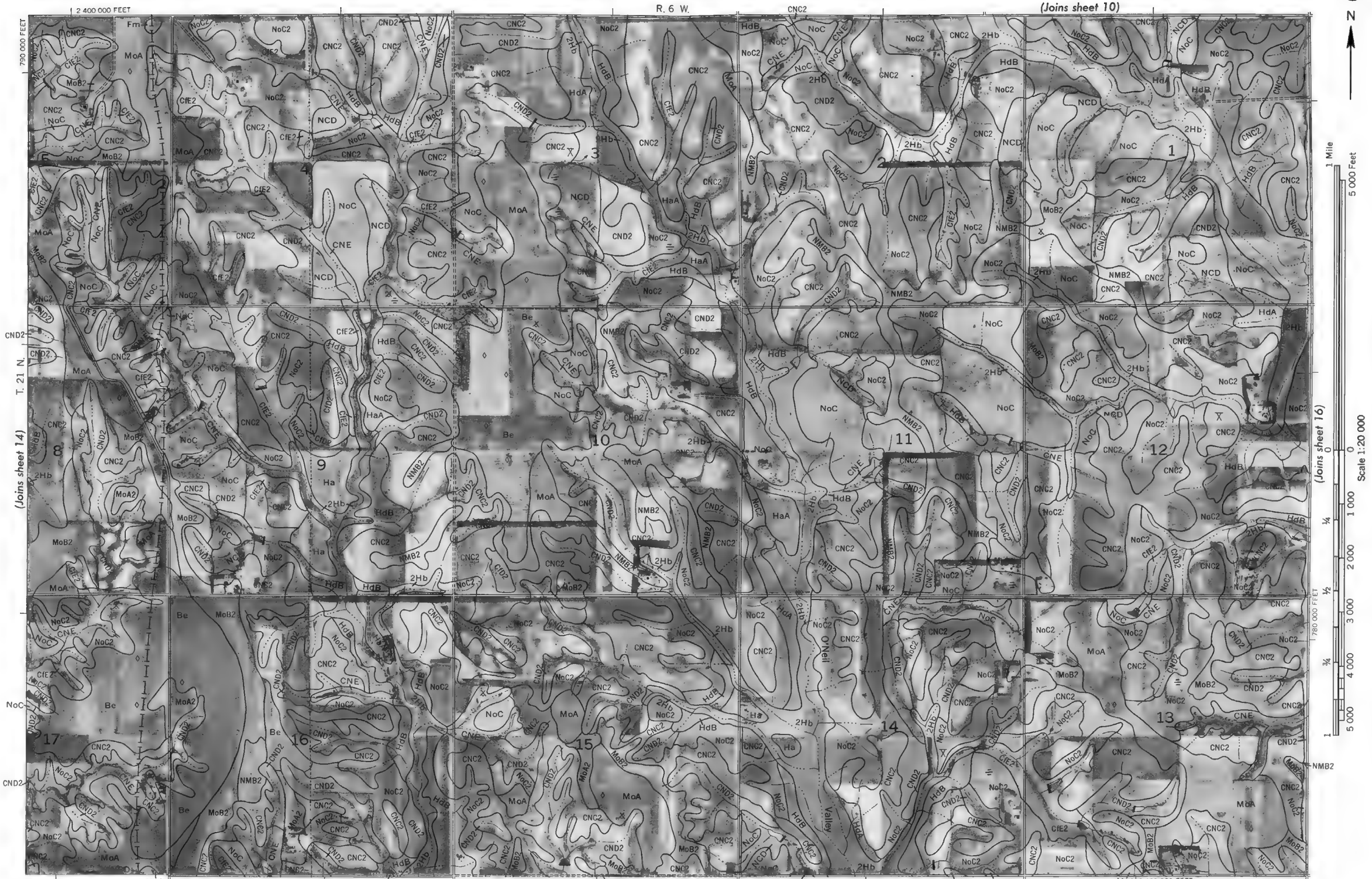
Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 15



BOONE COUNTY, NEBRASKA — SHEET NUMBER 16

16

N

2 425 000 FEET

790 000 FEET

(Joins sheet 11)

R. 5 W.

T. 21 N.

780 000 FEET

2 445 000 FEET

(Joins sheet 15)

(Joins sheet 17)

(Joins sheet 22)

1 Mile

5 000 Feet

Scale 1:20 000

South Branch Immanuel Church

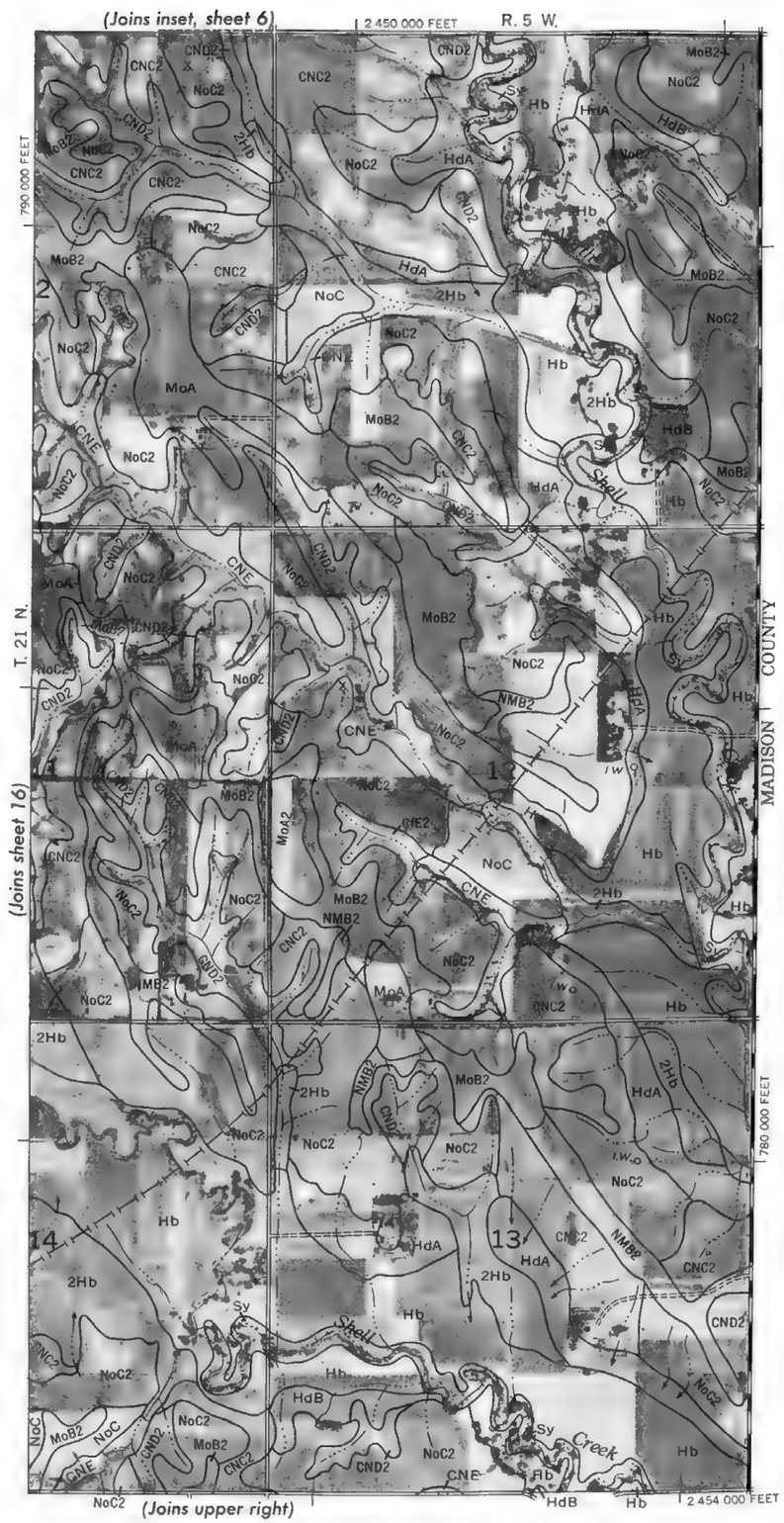
Creek

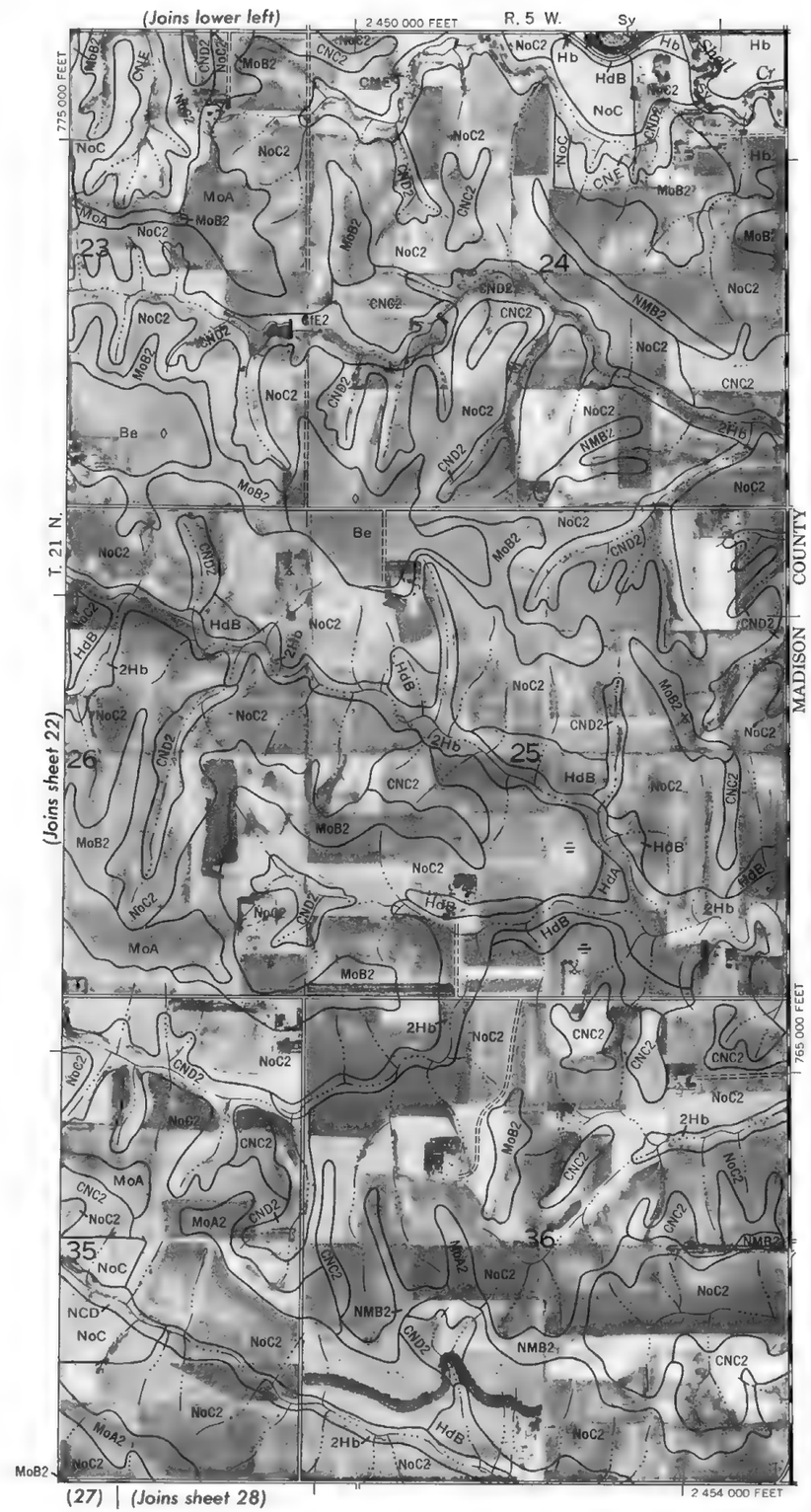
BOONE COUNTY, NEBRASKA NO. 16

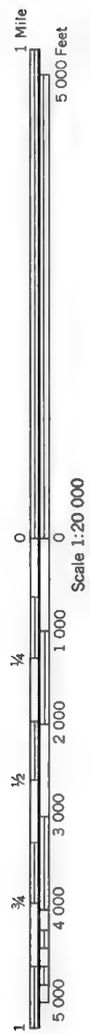
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 17







BOONE COUNTY, NEBRASKA NO. 17

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division. Land division corners are approximately positioned on this map.

GRID TICK INTERVAL 4000 FEET ON EAST-WEST LINE

N

R. 8 W.

2 330 000 FEET

(Joins sheet 12)

770 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

WHEELER COUNTY

T. 21 N.

(Joins sheet 19)

760 000 FEET

2 350 000 FEET

GREELEY CO

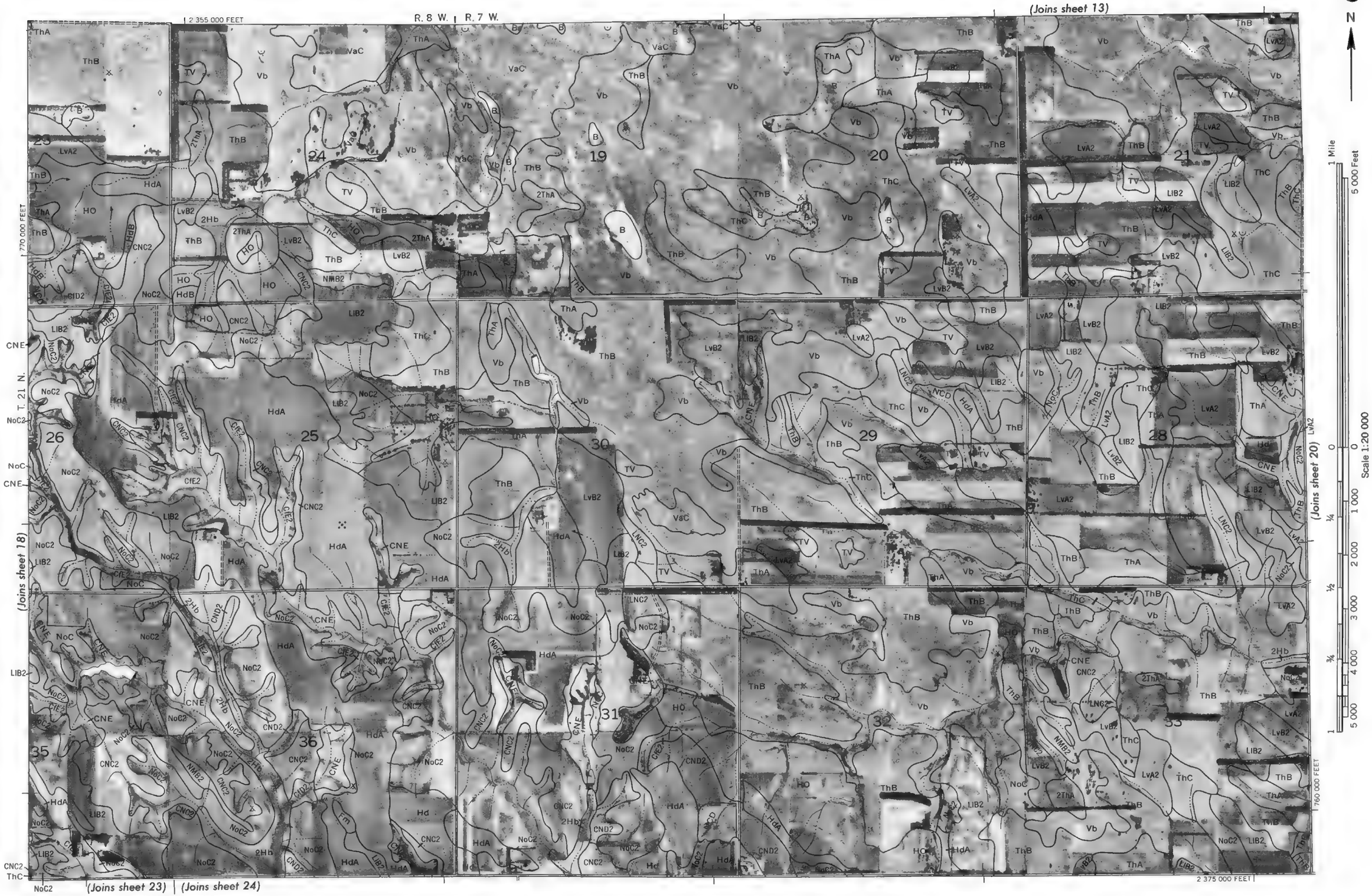
(Joins sheet 23)

AKRON CEMETERY

BOONE COUNTY, NEBRASKA NO. 18

Land division corners are approximately positioned on this map.

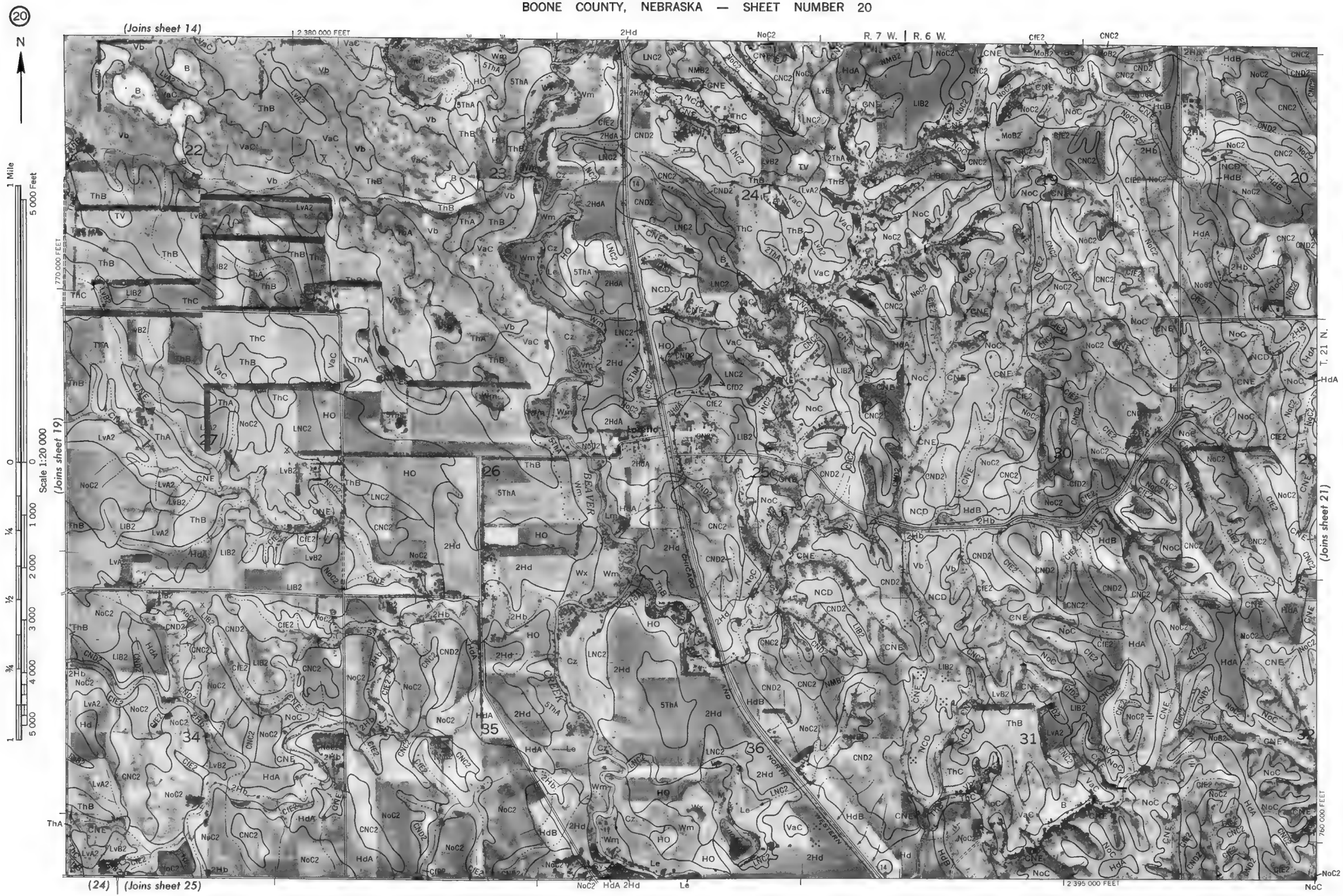
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.



BOONE COUNTY, NEBRASKA NO. 19

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division. Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 20

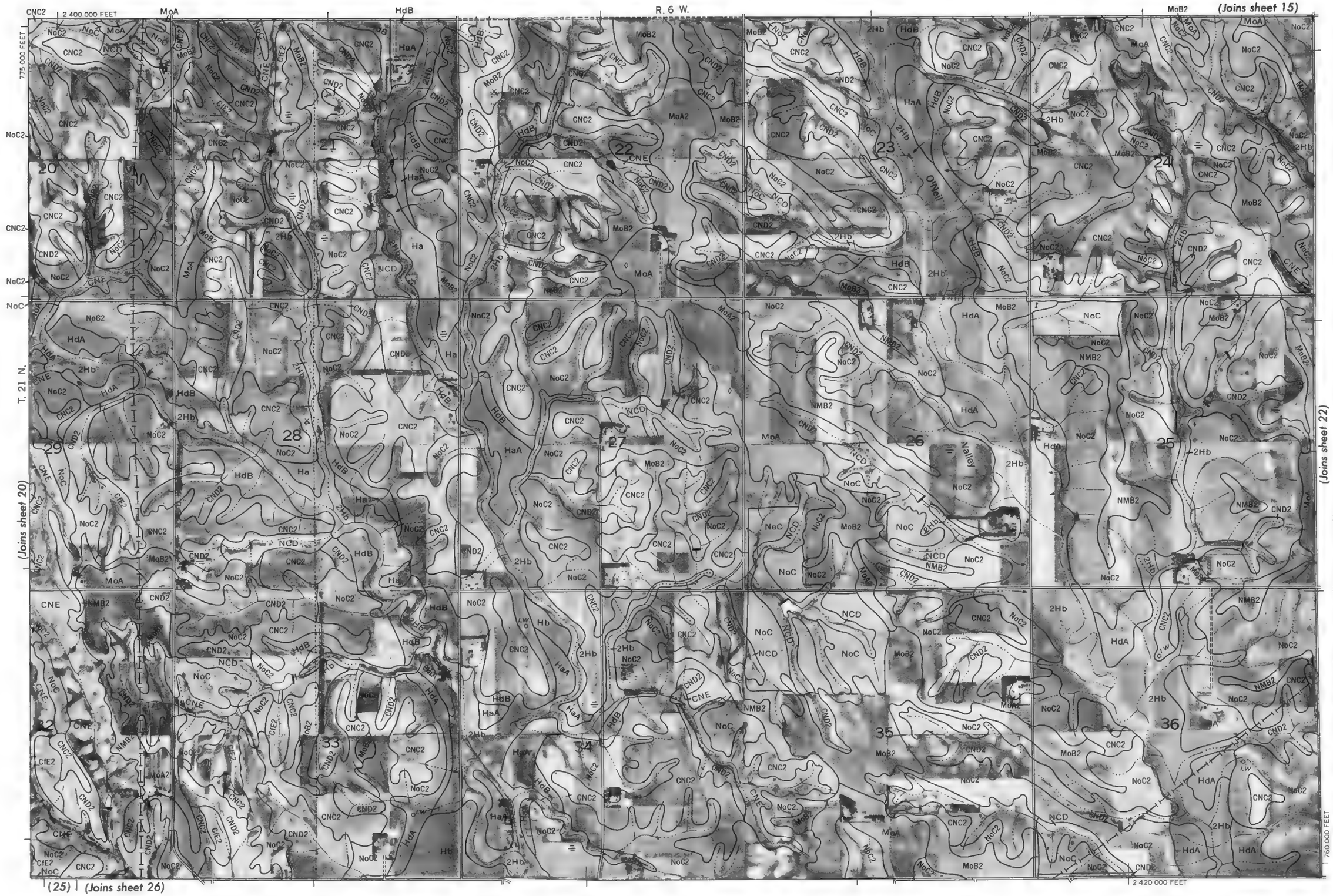


BOONE COUNTY, NEBRASKA NO. 20

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 21



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 21

(22)

N

(Joins sheet 16)

2 425 000 FEET

R. 5 W.

775 000 FEET

T. 21 N.

765 000 FEET

(Joins sheet 21)

(Joins inset, sheet 17)

1 Mile

5 000 Feet

Scale 1:20 000

0

1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

(26) (Joins sheet 27)

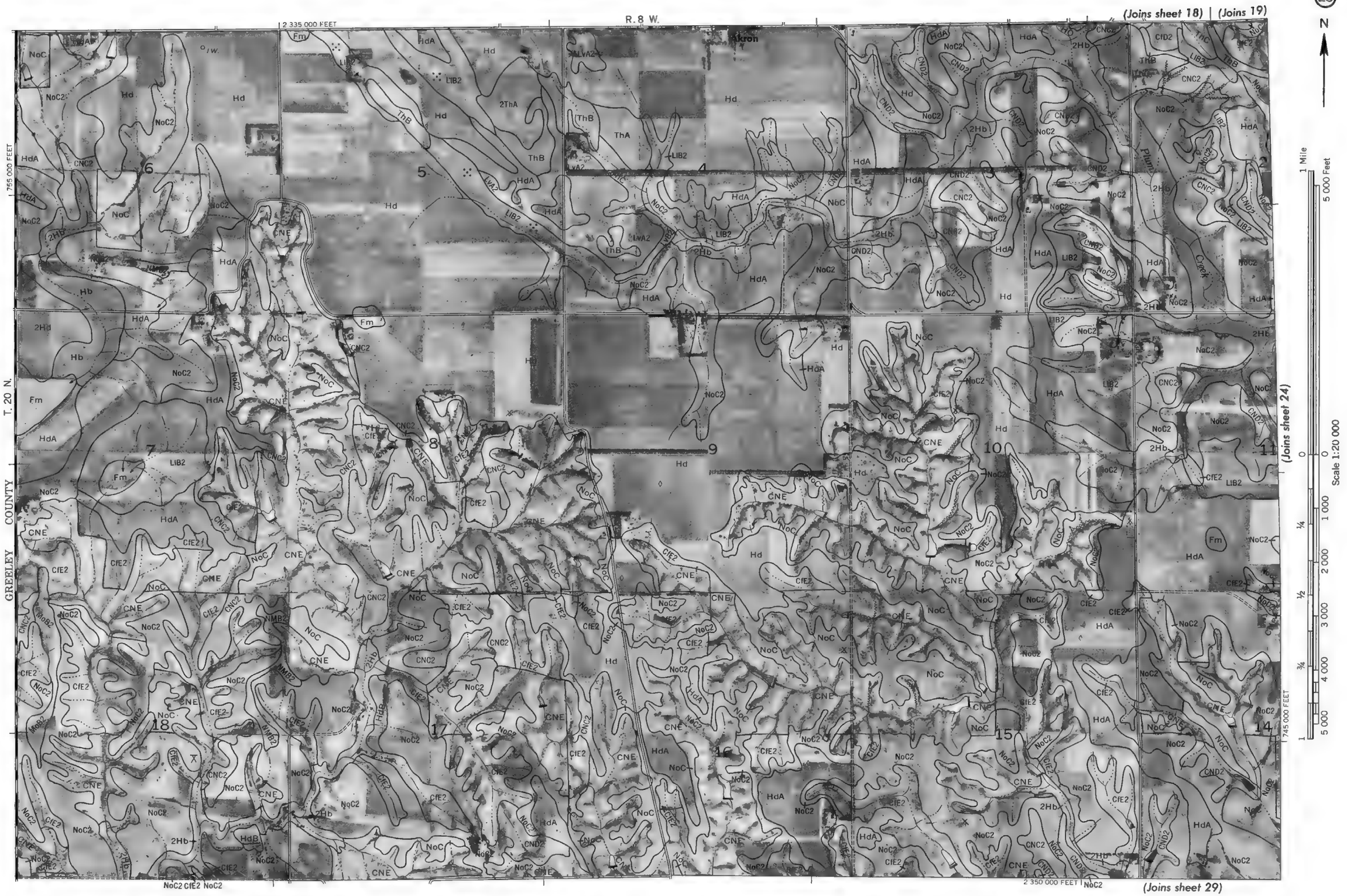
2 445 000 FEET

BOONE COUNTY, NEBRASKA NO. 22

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 23



BOONE COUNTY, NEBRASKA NO. 23

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 24

(24)

N

2 355 000 FEET

R. 8 W. | R. 7 W.

(Joins 19) | (Joins 20)

755 000 FEET

T. 20 N.

745 000 FEET

2 375 000 FEET

(Joins sheet 23)

(Joins sheet 25)

(Joins sheet 30)

1 Mile

5 000 Feet

Scale 1:20 000

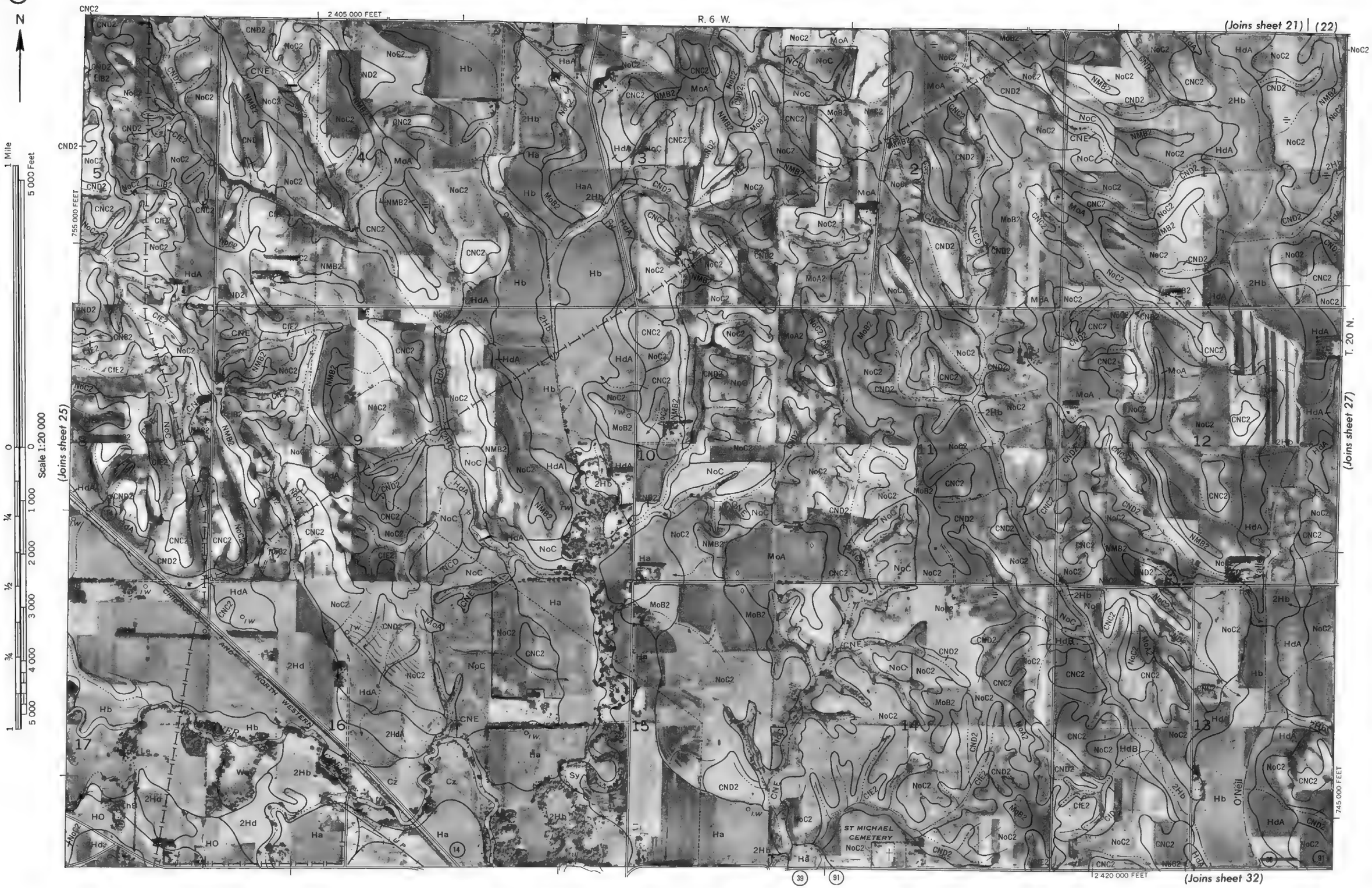
BOONE COUNTY, NEBRASKA NO. 24

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA NO. 25

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.



BOONE COUNTY, NEBRASKA NO. 26

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY NEBRASKA — SHEET NUMBER 27

(27)

N

(Joins sheet 22) | (inset, 17)

R. 5 W.

2 425 000 FEET

755 000 FEET

T. 20 N.

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 33)

2 445 000 FEET

745 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

BOONE COUNTY, NEBRASKA NO. 27

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.

28

N

1 Mile
5 000 Feet
Scale 1:20 000

(Joins sheet 27)

2 450 000 FEET

(Joins inset, sheet 17)

R. 5 W.

MADISON CO

760 000 FEET

PLATTE COUNTY

T. 20 N.

745 000 FEET

(Joins upper right)

2 455 000 FEET

(Joins lower left)

740 000 FEET

(Joins sheet 33)

730 000 FEET

(Joins sheet 39)

BOONE COUNTY, NEBRASKA NO. 28

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 29

29

N

R. 8 W.

2 335 000 FEET

740 000 FEET

T. 20 N.

GREELEY COUNTY

(Joins sheet 23)

(Joins sheet 30)

(Joins sheet 34)

2 350 000 FEET

730 000 FEET

1 Mile

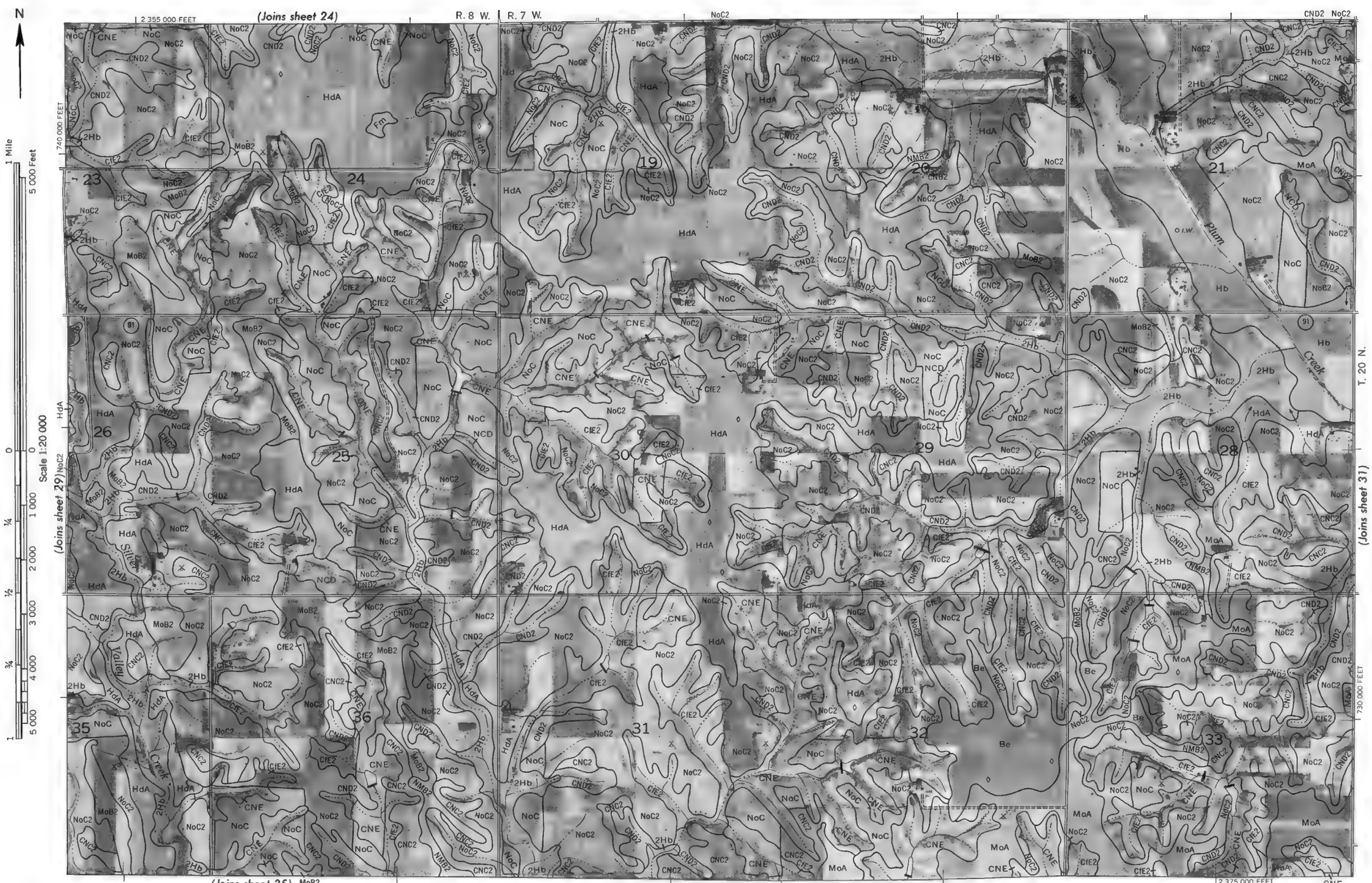
5 000 Feet

Scale 1:20 000

BOONE COUNTY, NEBRASKA NO. 29

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 30



BOONE COUNTY, NEBRASKA NO. 30

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 31

2 380 000 FEET

740 000 FEET

R. 7 W. | R. 6 W.

(Joins sheet 25)

T. 20 N.

(Joins sheet 30)

(Joins sheet 36)

2 400 000 FEET

730 000 FEET

(Joins sheet 32)

N

1 Mile

5 000 Feet

Scale 1:20 000

0 1/4 1/2 3/4 1

0 1 000 2 000 3 000 4 000 5 000

(32)

N

(Joins sheet 26)

2 405 000 FEET

R. 6 W.

740 000 FEET

ALBION

COUNTRY CLUB

BOONE COUNTY FAIRGROUND

ALBION CEMETERY

BEAVER CREEK

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA

NORTH WESTERN

UNION PACIFIC

O'Neil Valley

T. 20 N.

(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 37)

730 000 FEET

2 420 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

0 0

¼ 1 000

½ 2 000

¾ 4 000

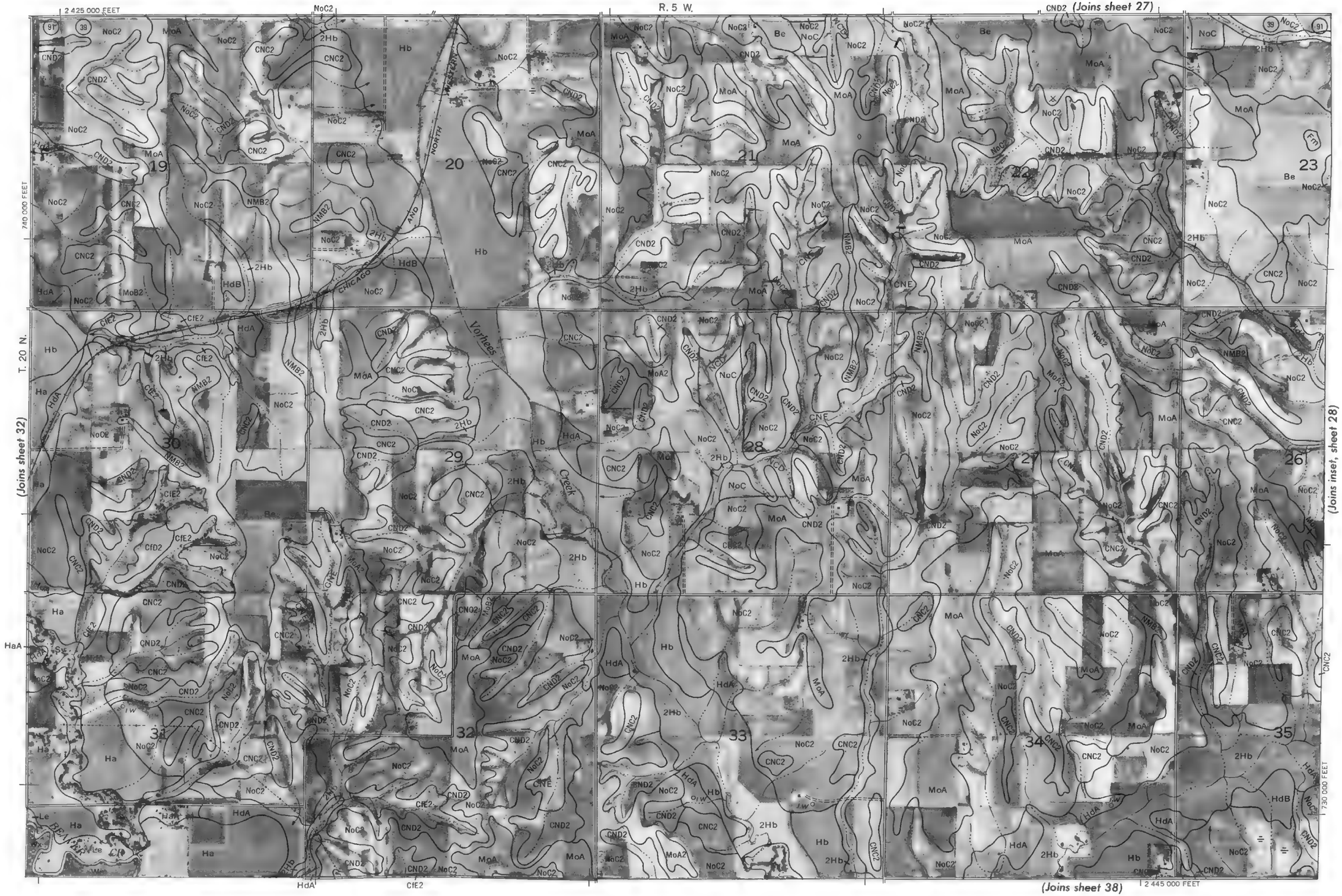
1 5 000

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA NO. 32

BOONE COUNTY, NEBRASKA — SHEET NUMBER 33



N

1 Mile

5 000 Feet

Scale 1:20 000

1 0 5 000 | ¼ 1 000 | ½ 2 000 | ¾ 4 000 | 1 3 000

BOONE COUNTY, NEBRASKA NO. 33

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division
Land division corners are approximately positioned on this map.

(34)

N

(Joins sheet 29) MoB2

2 335 000 FEET

R. 8 W.

725 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

0 0

1 5 000 | ¾ 4 000 | ½ 3 000 | ¼ 2 000 | 1 000

GREELEY COUNTY

DUBLIN CEMETERY

UNION PACIFIC

Primrose

T. 19 N.

715 000 FEET

2 350 000 FEET

(Joins sheet 35)

(Joins sheet 40)

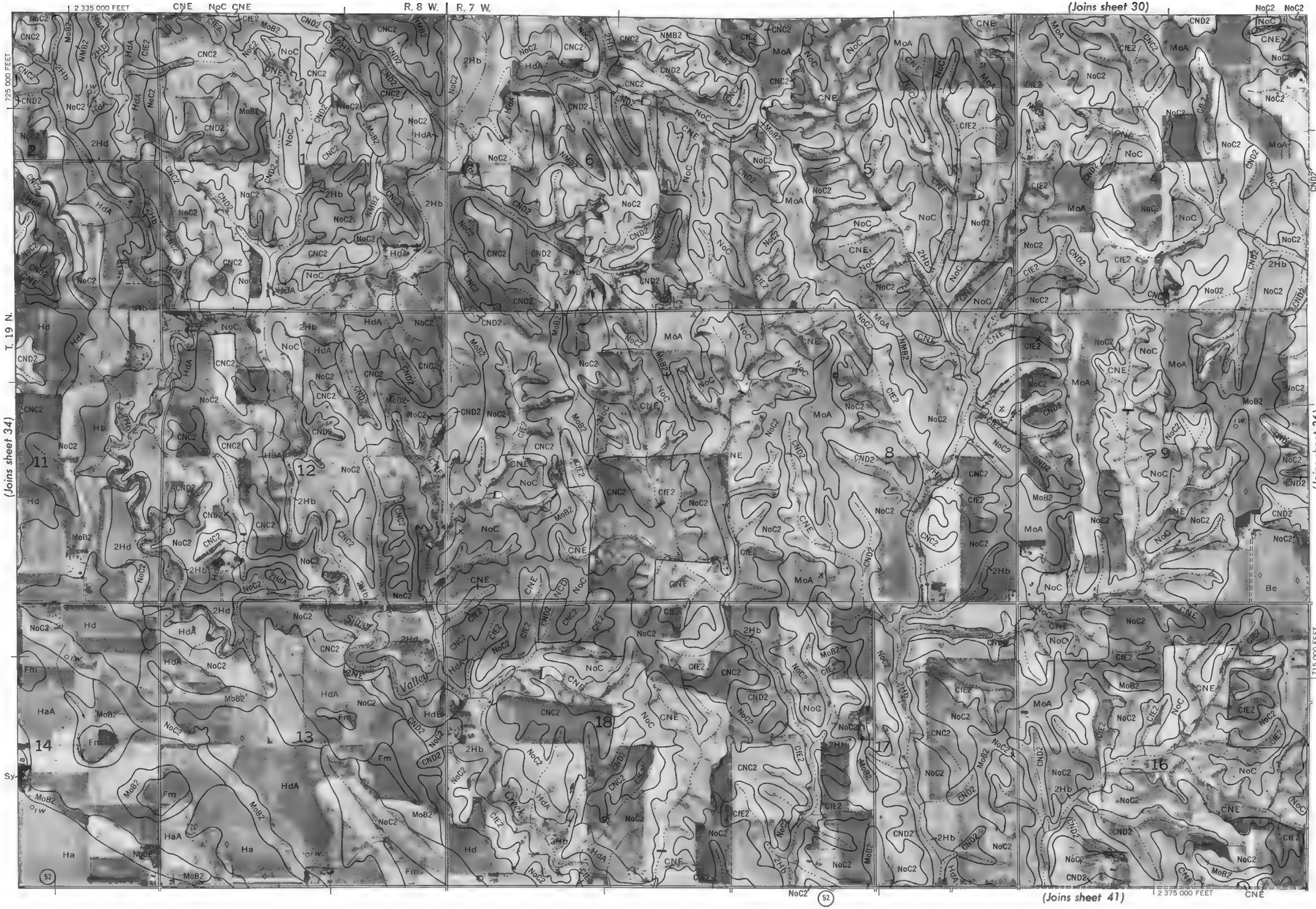
BOONE COUNTY, NEBRASKA NO. 34

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 35



BOONE COUNTY, NEBRASKA NO. 36

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 37

37

N

R. 6 W.

T. 19 N.

2 405 000 FEET

725 000 FEET

715 000 FEET

2 425 000 FEET

(Joins sheet 32)

(Joins sheet 36)

(Joins sheet 38)

(Joins sheet 43)

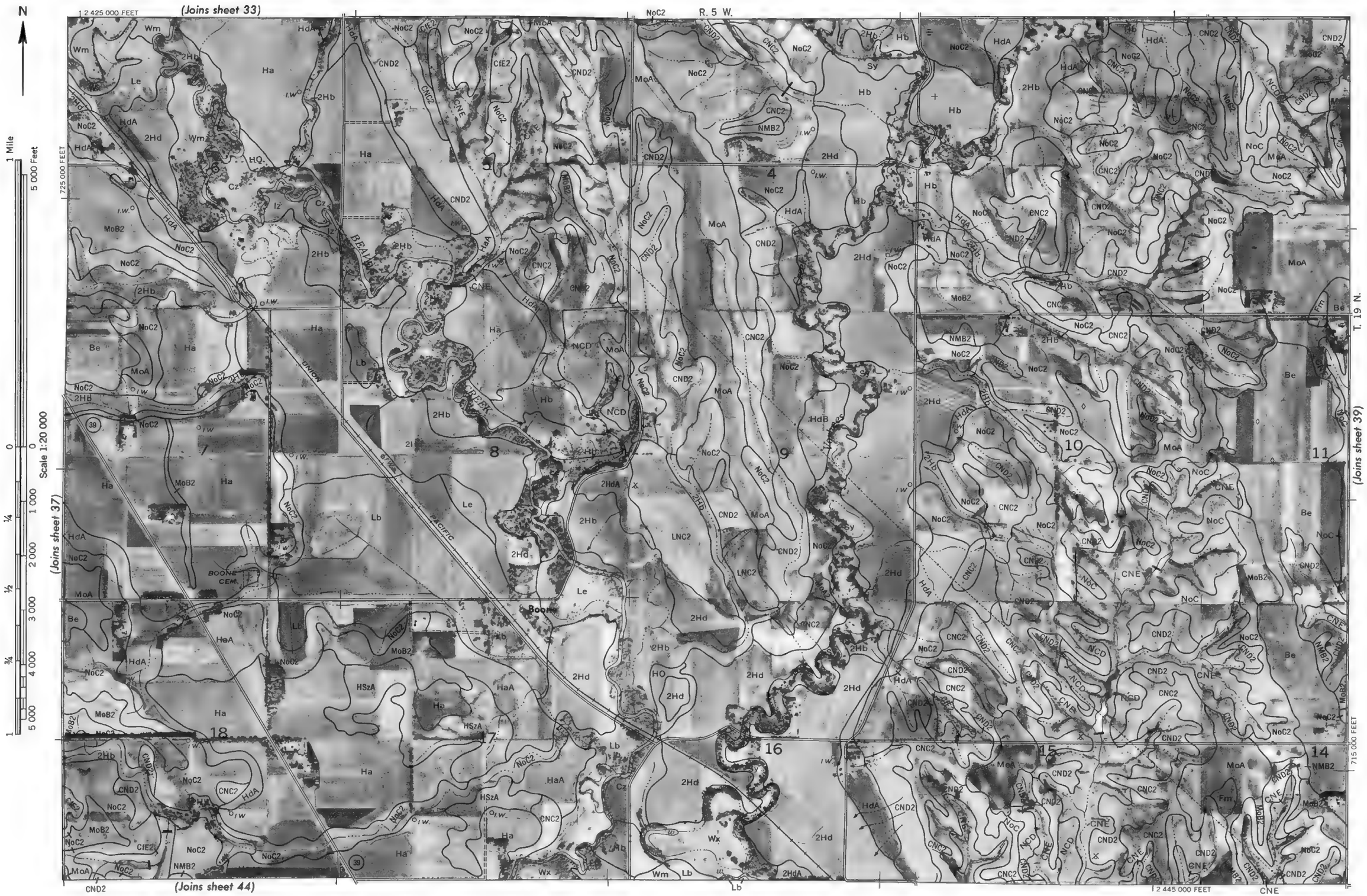
1 Mile

5 000 Feet

Scale 1:20 000

BOONE COUNTY, NEBRASKA NO. 37

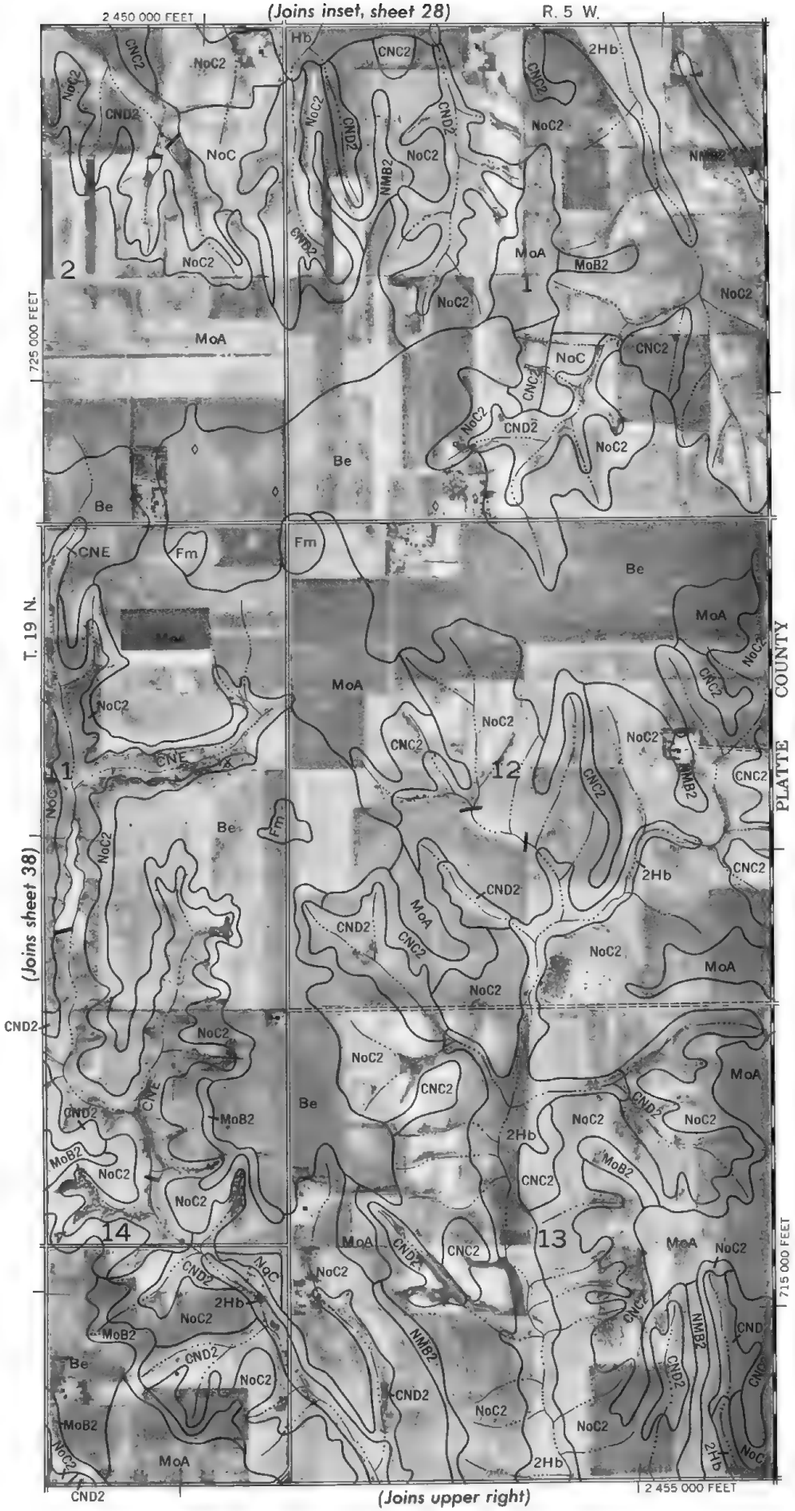
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.

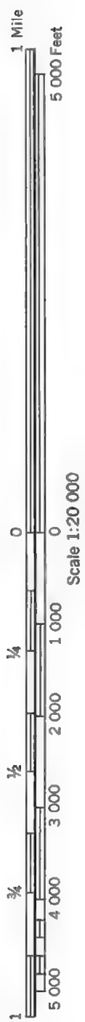


BOONE COUNTY, NEBRASKA NO. 38

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.





39

N

BOONE COUNTY, NEBRASKA NO. 39

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division. Land division corners are approximately positioned on this map.

(40)

N

(Joins sheet 34)

2 335 000 FEET

R. 8 W.

710 000 FEET

T. 19 N.

1 Mile 5 000 Feet

Scale 1:20 000

GREELEY COUNTY

(Joins sheet 41)

(Joins sheet 45)

2 350 000 FEET

695 000 FEET

BOONE COUNTY, NEBRASKA NO. 40

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 41

41

N

(Joins sheet 35)

R. 8 W. | R. 7 W.

2 355 000 FEET

710 000 FEET

T. 19 N.

(Joins sheet 40)

(Joins sheet 46)

(Joins sheet 42)

700 000 FEET

2 375 000 FEET

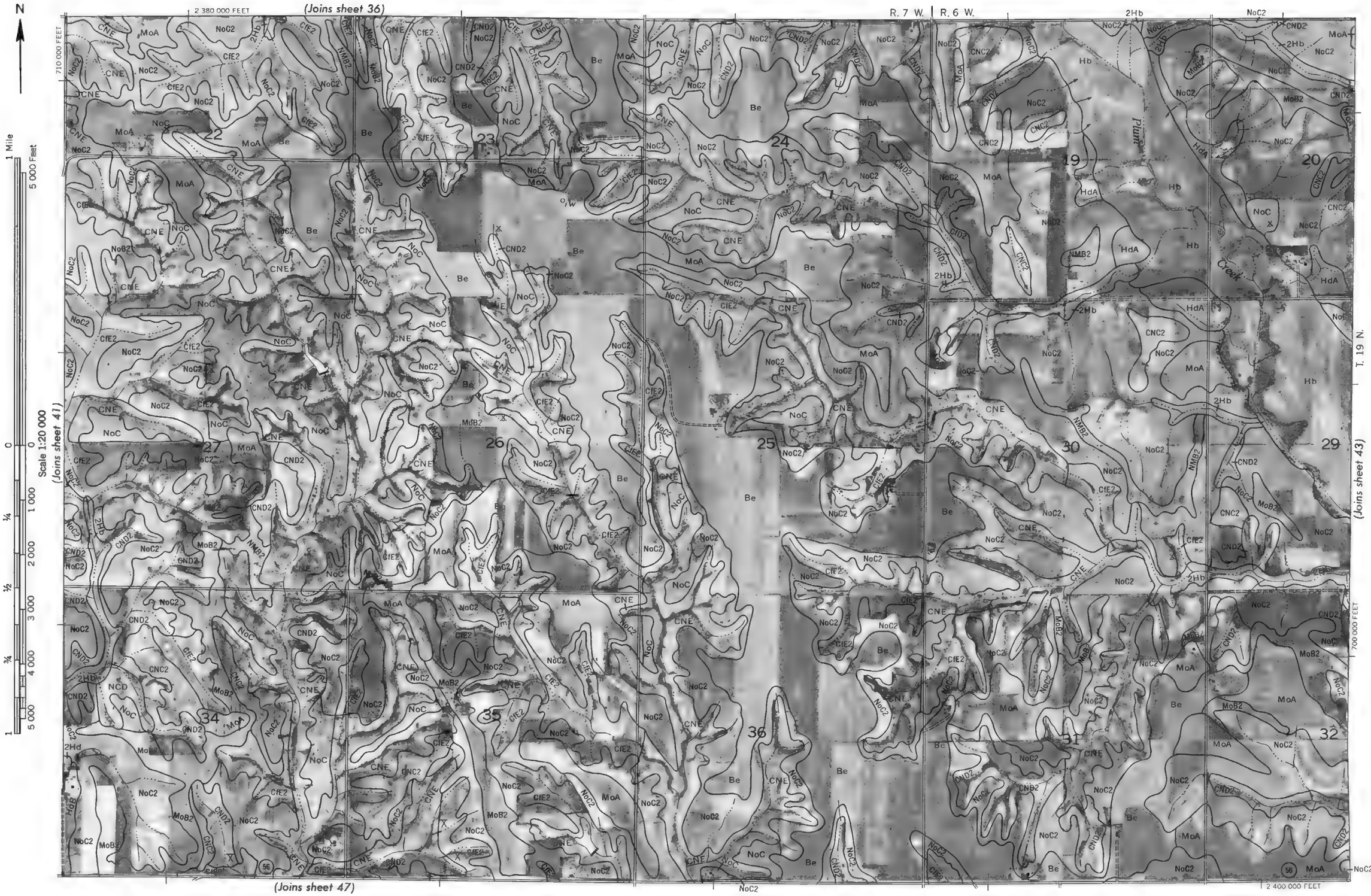
1 Mile

5 000 Feet

Scale 1:20 000

BOONE COUNTY, NEBRASKA NO. 41

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.



BOONE COUNTY, NEBRASKA NO. 42

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 43

43

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division. Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 43

2 405 000 FEET

710 000 FEET

R. 6 W.

T. 19 N.

(Joins sheet 37)

(Joins sheet 42)

(Joins sheet 44)

(Joins sheet 48)

2 425 000 FEET

700 000 FEET

N

1 Mile 0 5 000 Feet

Scale 1:20 000

1 5 000 ¾ 4 000 ½ 3 000 ¼ 2 000 0 1 000

BOONE COUNTY, NEBRASKA — SHEET NUMBER 44

(44)

N

2 425 000 FEET

(Joins sheet 38)

R. 5 W.

NCD

710 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

(Joins sheet 43)

T. 19 N.

700 000 FEET

(Joins sheet 39)

2 445 000 FEET

(Joins sheet 49)

BEAVER CR

Boyds Creek

UNION PACIFIC

SAINT EDWARD

BOONE COUNTY, NEBRASKA NO. 44

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 45

45

N

R. 8 W.

2 335 000 FEET

690 000 FEET

T. 18 N.

GREELEY COUNTY

(Joins sheet 40)

(Joins sheet 46)

(Joins sheet 51)

2 350 000 FEET

680 000 FEET

North Branch

Timber

CHELEY CEMETERY

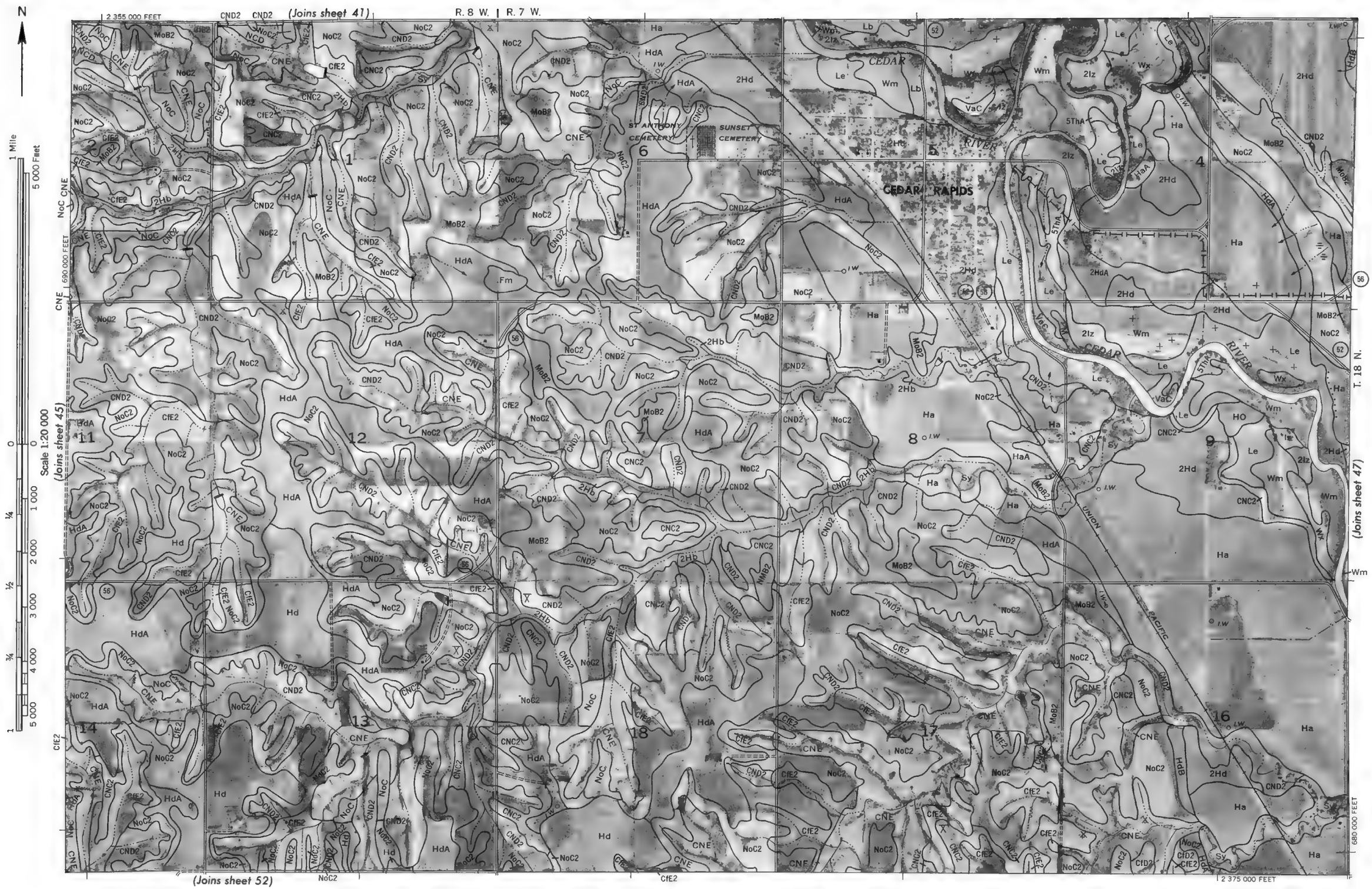
1 Mile

5 000 Feet

Scale 1:20 000

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division. Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 45

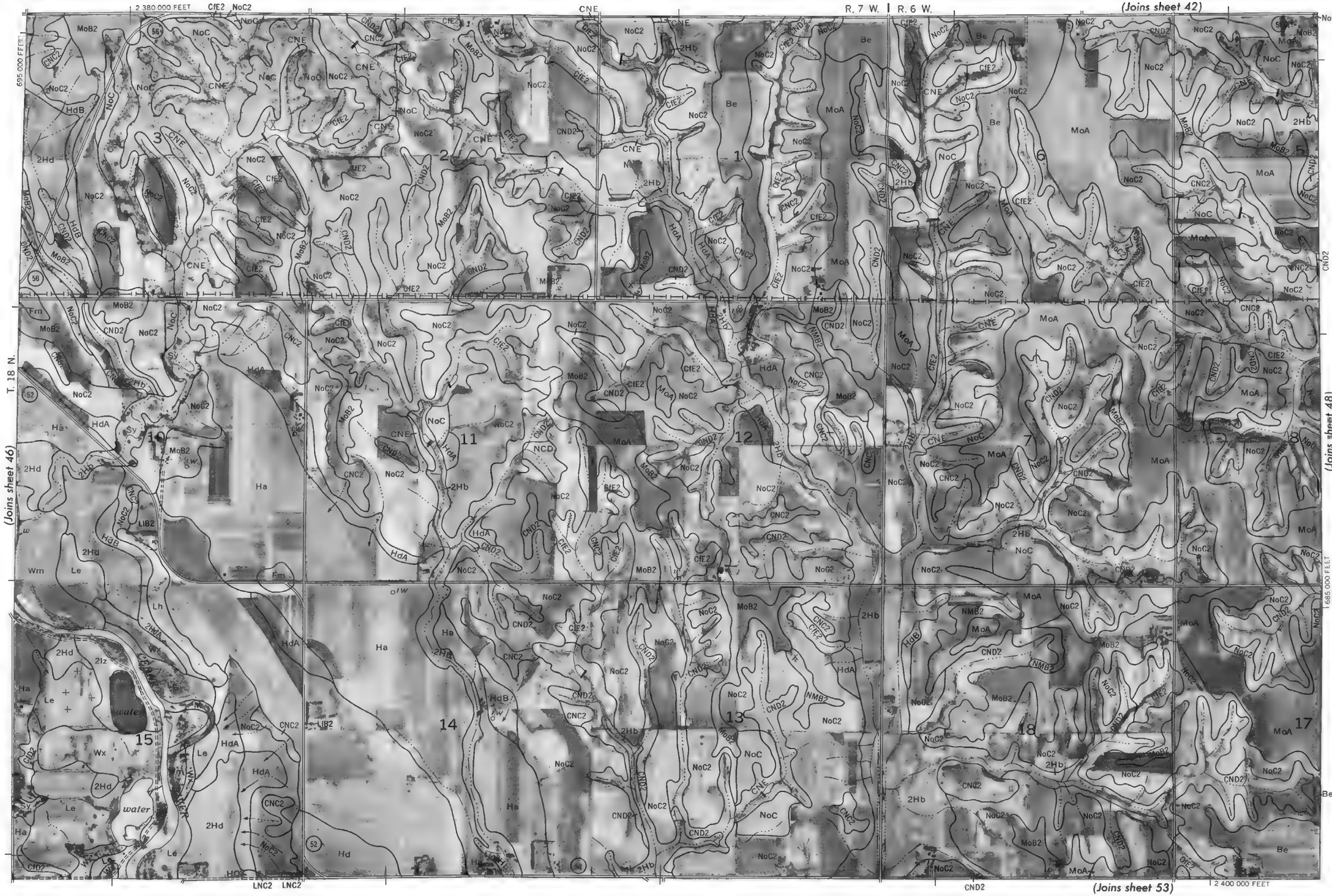


BOONE COUNTY, NEBRASKA NO. 46

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 47



BOONE COUNTY, NEBRASKA NO. 47

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.

(48)

N

(Joins sheet 43)

2 405 000 FEET

R. 6 W.

695 000 FEET

T. 18 N.

685 000 FEET

2 425 000 FEET

(Joins sheet 47)

(Joins sheet 49)

(Joins sheet 54)

1 Mile

5 000 Feet

Scale 1:20 000

0 0 1 000 2 000 3 000 4 000 5 000

¼ ½ ¾ 1

BOONE COUNTY, NEBRASKA NO. 48

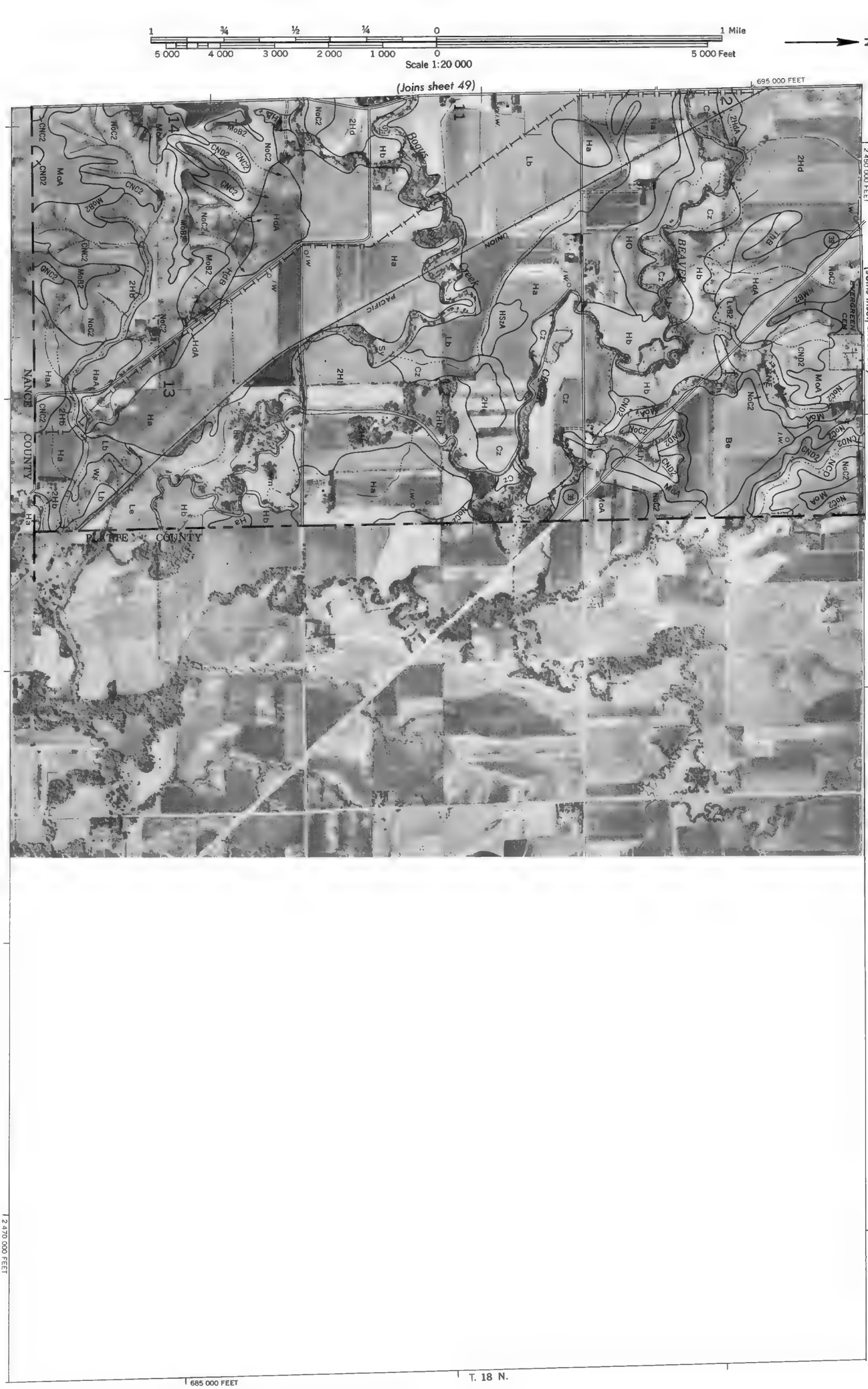
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

BOONE COUNTY, NEBRASKA — SHEET NUMBER 49

BOONE COUNTY, NEBRASKA NO. 49

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.



BOONE COUNTY, NEBRASKA — SHEET NUMBER 50

BOONE COUNTY, NEBRASKA NO. 50

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 51

(51)

N

R. 8 W.

2 335 000 FEET

675 000 FEET

T. 18 N.

(Joins sheet 45)

(Joins sheet 52)

2 350 000 FEET

665 000 FEET

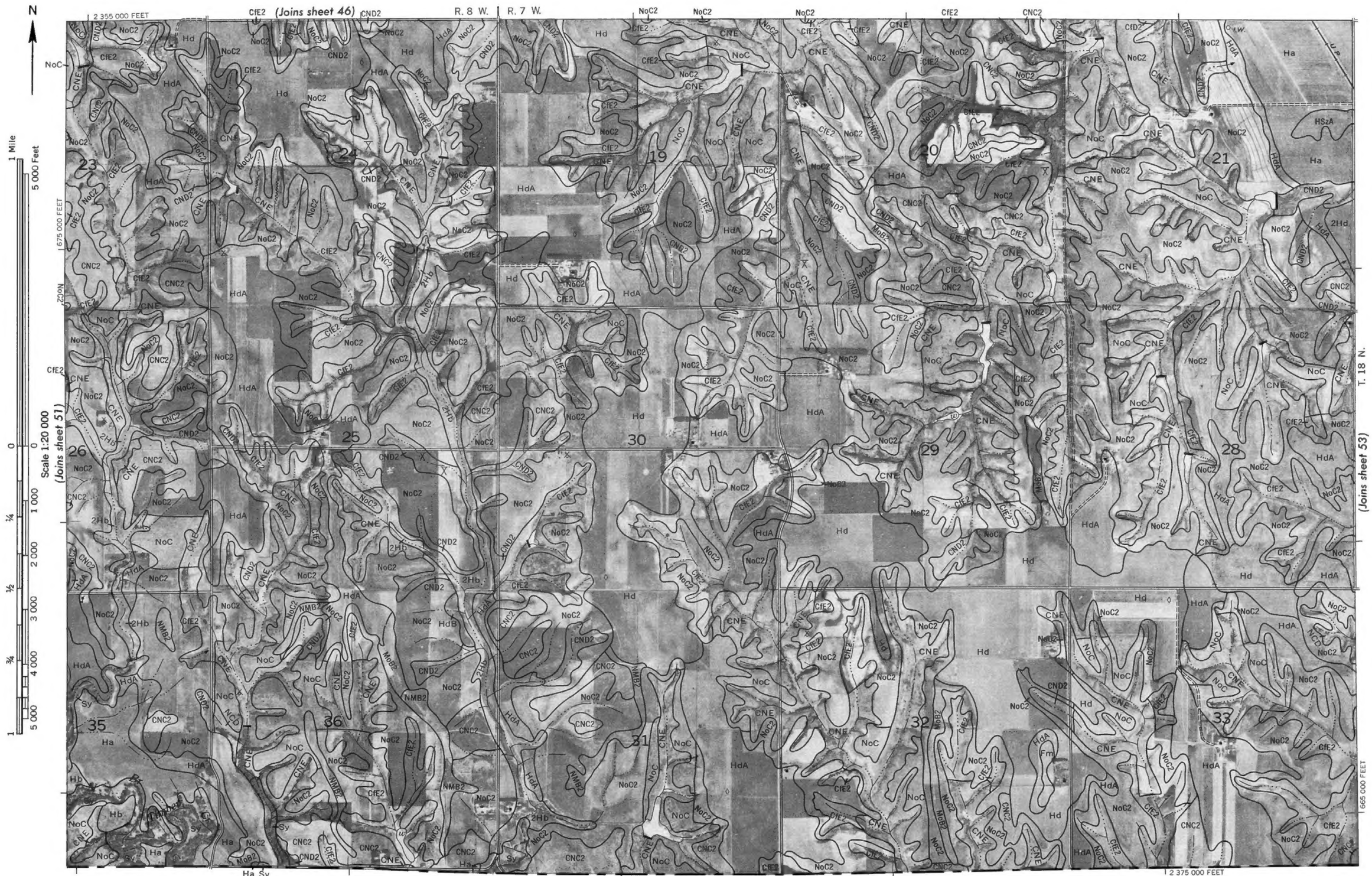
GREELEY COUNTY

NANCE COUNTY

1 Mile

5 000 Feet

Scale 1:20 000



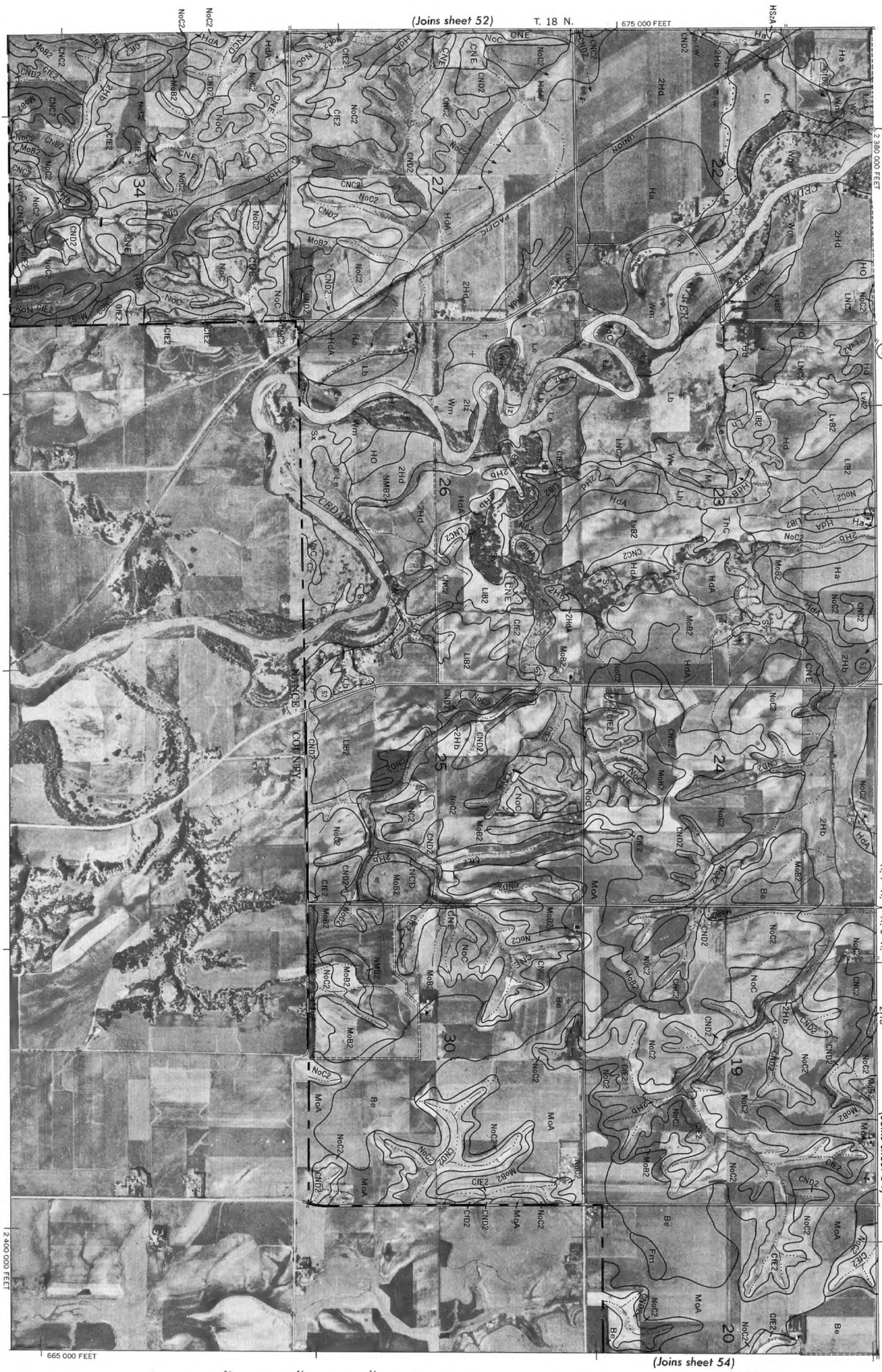
BOONE COUNTY, NEBRASKA NO. 52

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Land division corners are approximately positioned on this map.

BOONE COUNTY, NEBRASKA NO. 53



BOONE COUNTY, NEBRASKA — SHEET NUMBER 53

53

N

Scale 1:20 000

1 Mile 5 000 Feet

0 0 ¼ ½ ¾ 1

1 5 000 ¾ 4 000 ½ 3 000 ¼ 2 000 1 000

GRID TICK INTERVAL 3000 FEET ON NORTH-SOUTH LINE

BOONE COUNTY, NEBRASKA NO. 54

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.